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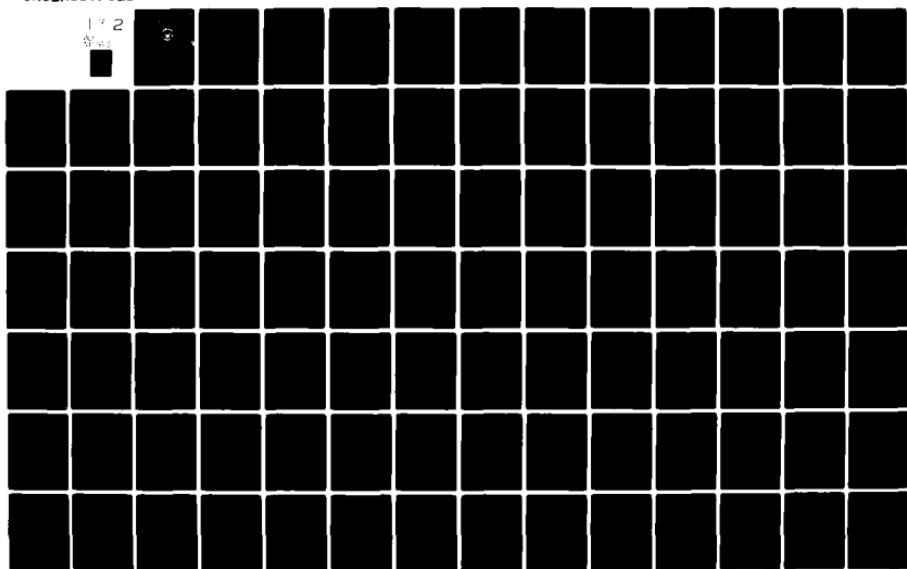
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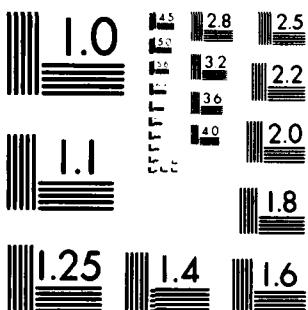
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THESIS

AN APPLE II IMPLEMENTATION OF MAN-MOD
MANPOWER PLANNING MODEL

by

James Lee Downs II

March 1982

Thesis Advisors:

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| REPORT DOCUMENTATION PAGE | | | READ INSTRUCTIONS BEFORE COMPLETING FORM |
|--|-----------------------|---|--|
| 1. REPORT NUMBER | 2. GOVT ACCESSION NO. | 3. RECIPIENT'S CATALOG NUMBER | |
| | | AD-4117612 | |
| 4. TITLE (and Subtitle) | | 5. TYPE OF REPORT & PERIOD COVERED | |
| An Apple II Implementation of Man-Mod Manpower Planning Model | | Master's Thesis March 1982 | |
| 6. AUTHOR(S) | | 7. CONTRACT OR GRANT NUMBER(S) | |
| James Lee Downs II | | | |
| 8. PERFORMING ORGANIZATION NAME AND ADDRESS | | 10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS | |
| Naval Postgraduate School Monterey, California 93940 | | | |
| 11. CONTROLLING OFFICE NAME AND ADDRESS | | 12. REPORT DATE | |
| Naval Postgraduate School Monterey, California 93940 | | March 1982 | |
| 14. MONITORING AGENCY NAME & ADDRESS (if different from Controlling Office) | | 15. NUMBER OF PAGES | |
| | | 143 | |
| 16. DISTRIBUTION STATEMENT (of this Report) | | 18. SECURITY CLASS. (of this report) | |
| Approved for public release; distribution unlimited. | | Unclassified | |
| 17. DISTRIBUTION STATEMENT (of the abstract entered in Block 20, if different from Report) | | 18a. DECLASSIFICATION/DOWNGRADING SCHEDULE | |
| 19. SUPPLEMENTARY NOTES | | | |
| 19. KEY WORDS (Continue on reverse side if necessary and identify by block number) | | | |
| Apple II Plus Microcomputer Transition Flow Model Markov Chain Manpower Requirements | | | |
| 20. ABSTRACT (Continue on reverse side if necessary and identify by block number) | | | |
| This thesis presents an Apple II Markov chain model software package programmed to be flexible, practical, and user interactive. The program addresses the future determination of manpower requirements by an application of a limited Markov chain model, a discrete time Markov process with a stochastic matrix of transition probabilities. The user may manipulate data inputs to vary outcome effects. The program was written in Applesoft, an Apple II basic language. It has the capability to store, retrieve, and modify data for use with the | | | |

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An Apple II Implementation of the Man-Mod
Manpower Planning Model

by

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Lieutenant Commander, United States Navy
B.S.C., University of Louisville, 1965

Submitted in partial fulfillment of the
requirements for the degree of

MASTER OF SCIENCE IN MANAGEMENT

from the

NAVAL POSTGRADUATE SCHOOL
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ABSTRACT

This thesis presents an Apple II Markov chain model software package programmed to be flexible, practical, and user interactive. The program addresses the future determination of manpower requirements by an application of a limited Markov chain model, a discrete time Markov process with a stochastic matrix of transition probabilities. The user may manipulate data inputs to vary outcome effects. The program was written in Applesoft, an Apple II basic language. It has the capability to store, retrieve, and modify data for use with the calculation procedures. The program can be easily modified or enhanced to allow for inclusion or utilization of other models.

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ACKNOWLEDGMENT

The author would like to thank professors Richard S. Elster and James D. Esary for their assistance and support with the MAN-MOD Apple adaptation. A special thanks to the author's wife, Sandra, whose understanding was stretched to the limits, but without whose help this thesis would not have been completed.

TRANSMITTAL

INTRODUCTION

The objective of this thesis is to provide an interactive learning aid in evaluating policies and their effect on manpower requirements. These requirements have been a problem in manning the All-Volunteer Force since its inception. Without the steady flow of personnel into the armed forces prevalent with the draft, it has become increasingly necessary to make an in-depth examination of policies relating to manpower requirements.

For the manpower analyst, or for that matter anyone who utilizes the methodology and problem solving approach of the manpower analyst, some form of a computational device is a necessity. Cost, rigid interface requirements, and a number of other factors have in the past frustrated and stifled the analyst in focusing the necessary computational power on his problem.

In the early 1970's, programmable hand-held calculators were introduced. They gave the analyst a significant amount of computing power packaged in a portable unit. The impact these devices made on manpower analyses was extremely important in real time studies. However, in

spite of the tremendous impact of hand-held calculators, this contribution is yielding to the greater capability found in the microcomputer.

In view of the prospective proliferation of microcomputers and the significant computing power that they now provide, the analyst can ill afford to neglect their capabilities. Today compatible software to support the capabilities is seriously lacking in specialized fields such as manpower analysis. It is this software application that this thesis addresses.

MICROCOMPUTER SYSTEM

Software development was done on an Apple II Plus microcomputer with a 5 1/4 inch floppy-disk drive as an add on peripheral. The standard Apple computer presents a forty column, twenty four line display which is compatible with a standard television set or a commercial monitor. The output format for the program is written to be viewed in forty columns and to be compatible with any standard Apple II Plus operating system with a single disk drive.

SOFTWARE DEVELOPMENT

R. F. Ling's article, "General Considerations on the Design of an Interactive System for Data Analysis", brought out several considerations which should be observed in the development of software for any kind of analysis. Among these considerations are: choice of programming language,

computational efficiency, portability, information retrieval, and user interface.

Although several microcomputer languages are available with individual features which are attractive, the language used in this software development effort was Applesoft basic, a "real precision" or "floating point" basic. Basic was one of the first high level languages introduced to teach programming techniques and style. The language exploits the fundamental programming concepts, permitting the user to write large, complex computer programs. Although a basic language is not structured in concept, the program was written in a modular fashion (i.e., in logical sub-packages which can be individually programmed, debugged, and validated.). The sub-packages are combined into a menu driven overall package. The program was written with five modules, each having its own sub-modules.

In spite of their impressive capabilities, microcomputers cannot compare to larger computers in computational speed and accuracy. Applesoft basic, as implemented on the Apple, will only perform computations using nine significant figures. The program written is limited and will only handle inputs, displays, or print outs to six figures; any number greater than 999999 will result in a >>>>> display. Percentages greater than three figures will result in the same >>> display. While Applesoft basic is

relatively slow as an interpreted language, the program and microcomputer still provide immediate results, approximately one second per calculation.

A portable program can be run on a number of different computer systems. While many higher languages provide this capability, basic languages are deficient in portability. The basic languages for microcomputers are all similar, but each has syntax and commands characteristic to itself. Therefore, a basic program written for the Apple computer will not run on another computer without modification. While basic is not the best language choice for portability, it is both user and programmer friendly.

Information retrieval is an aspect of a program which permits an analyst to use it efficiently. The program was designed to provide the user with the ability to store and retrieve data files.

The last and most important consideration is a simple user interface. To utilize any program, the user must interact with the program, make numerical entries, and select desired calculation routines and options. Input or response requirements which are unfamiliar or misunderstood by the user can cause program interruptions or require reinitialization. This is undesirable. Programs should be written with the intent of establishing a dialogue with the user. The program should be as trouble free as possible for the user, and minimize the user's chances of committing

a fatal error when responding to program prompts or entering data. Procedures to accomplish this are costly in terms of computational efficiency and programming steps; however, user convenience is worth the cost. The program was written with this objective in mind.

MAN-MOD

The program, MAN-MOD, is an Apple II Plus adaptation of a Markov chain model. It was adapted from a larger computer manpower planning model called MAN-MOD, for use on the Apple computer. A Users' Manual was written to assist the user in utilizing the program. The actual program is user oriented and menu driven, prompting the user for inputs. A minimal knowledge of the microcomputer is required. The Users' Manual provides the knowledge needed to use the MAN-MOD program. It provides initialization procedures and a step by step program review. There are calculation and input examples for the new user to review, as well as general program and interface information. The Users' Manual is contained within this thesis. The modules comprising the MAN-MOD program are listed in Appendices A - E.

PROGRAM DESCRIPTION

The MAN-MOD program addresses the future determination of manpower requirements by utilizing a discrete time Markov chain with a stochastic matrix of transition

probabilities. The user may manipulate data inputs to study various outcomes. All inputs are prompted.

When the program is initialized, the user begins at the "outer level". To proceed he must press the return key which will load the main module and present the main menu, Display 2 in the User's Manual. From here he selects the option he desires and responds to the screen prompts as required. All responses and inputs are intended to be as trouble free as possible for the user. The user may return to the main menu from the sub-routines by selecting the (E), escape, key within a routine, or by selecting the return menu choice. The program and Users' Manual provide the necessary information to use MAN-MOD.

CONCLUSIONS

With the advent of the microcomputer, and its affordable role in special fields such as manpower analysis, the analyst will have increasing access to computational power in the 1980's. Providing specialized software will compliment this power.

The software package provided here gives the analyst a useful means of studying manpower requirements using the Apple II Plus microcomputer. The modules contained within the MAN-MOD package are designed to be easy for the analyst to use and to cushion, as much as possible, potential user mistakes. The calculation algorithms used are identical to those used in the larger computer MAN-MOD program, but

expressed in the Apple's basic language. The MAN-MOD adaptation has been programmed to be compatible with the microcomputer's size and computing precision.

Being written in a modular design, the MAN-MOD program may easily be enhanced by the addition of new modules, or by the modification of existing modules. For example, the MAN-MOD program module could be modified to allow utilization of the Markov vacancy model.

This package, and hopefully those to follow, can have a significant impact in manpower analysis. The analyst can be allowed to work independently, examining a greater variety of situations. Perhaps of equal importance, its use in the educational environment can accustom the analyst to the capabilities that should be available for his use in a working environment.

MAN-MOD TRANSITIONAL FLOW MODEL

USERS' MANUAL

**"An Apple II Implementation of the Man-Mod
Manpower Planning Model"**

Programmer

James Lee Downs

Advisors

Richard S. Elster

James D. Esary

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MAN-MOD TRANSITIONAL FLOW MODEL

Users' Manual

INTRODUCTION

MAN-MOD is an Apple II adaptation of Bartholomew and Forbes' "BASEQN" - a Markov transition model. The Apple Man-Mod transitional flow matrix program is designed to permit real time manpower data analyses. The program is user interactive, prompting the user for inputs as the model develops. The following instructions and illustrations will give the user a better understanding of the computer-user interaction and the model's capabilities. A basic explanation of the underlying theory is contained within the program as a menu choice. Bartholomew and Forbes' Statistical Techniques for Manpower Planning is recommended for a more detailed explanation.

SYSTEM HARDWARE

The suggested system configuration is:

1. 48K APPLE II PLUS computer with monitor.
2. DISK II and controller card.
3. Printer and interface card.

SYSTEM SOFTWARE

MAN-MOD, written in Applesoft Basic, is modular in design. The program consists of three modules, MAN-MOD/HELLO, MAN-MOD/PROGRAM, MAN-MOD/THEORY, and utilizes two

machine language routines, MAN-MOD/LINKER and MAN-MOD/ FORMATTER.

MAN-MOD/HELLO is the initialization program providing variable dimensioning, machine language routine loading, and a brief terminology review. It chains into the MAN-MOD/PROGRAM.

MAN-MOD/PROGRAM is the main module providing a menu for branching to desired options. It provides the INPUT, RECALL, and SAVE capabilities, along with the data calculations and output. It chains to the MAN-MOD/THEORY module.

The MAN-MOD/THEORY module provides basic explanations of theory, calculation options, and variable definitions. Its also contains a reference and acknowledgment section. It chains back to the MAN-MOD/PROGRAM module.

The two machine language routines connect the individual modules and provide for number formatting. MAN-MOD/LINKER is a public domain routine allowing individual program interconnection or chaining. MAN-MOD/FORMATTER is a print using routine allowing real and integer numbers to be formatted. It is a modified version of PRINT II, a Computer Systems Design copyrighted program. Permission has been obtained to utilize the modified routine for MAN-MOD; any other use of the routine is prohibited. Program listings are contained in the thesis, "An Apple II Implementation of the Man-Mod Manpower Planning Model", by James L. Downs, March 1982, Naval Postgraduate School, Monterey, Ca.

STARTING UP

Starting up requires system initialization and disk booting. Booting is a term for placing the disk in the disk drive and turning the computer on. A disk is a magnetic storage device that allows the retention and recall of data.

The following steps are required to initialize the MAN-MOD program:

1. Place the MAN-MOD program disk in disk Drive 1.
2. Turn the video monitor on.
3. Turn the printer on (an Apple Silentype printer is not required to be turned on).
4. Reach behind the Apple II computer on the left side and turn the computer on.

Once the preceding initialization steps are completed, the following things will occur.

TERMINOLOGY

The red light on the disk drive will come on, the disk drive will start up, and this acknowledgment will be printed on the screen:

MAN-MOD IS
AN APPLE ADAPTATION OF
BARTHOLOMEW AND FORBES'
"BASEQN" - A MARKOV TRANSITION MODEL

There will be a pause, and the screen will then display a review of five basic terms. The list covers terms to which the user will frequently respond. The monitor screen is shown in Display 1.

* MAN-MOD TRANSITION MATRIX PROGRAM *

<TERMINOLOGY REVIEW>

(A) ACCEPT: ACCEPT SCREEN DISPLAY, PROCEED TO NEXT ROUTINE

(E) ESCAPE: ABORT PRESENT ROUTINE, RETURN TO MENU

INPUT: CALLS FOR A DATA INPUT, ONCE ENTERED PRESS RETURN

PRESS: SELECT CHOICE OF SCREEN OPTIONS, AND PRESS CHOICE

(R) REENTER: RE-INPUT VALUES DISPLAYED ON SCREEN

.....
PRESS RETURN TO CONTINUE

<DISPLAY 1>

At the bottom of Display 1, the following line is shown:

PRESS RETURN TO CONTINUE

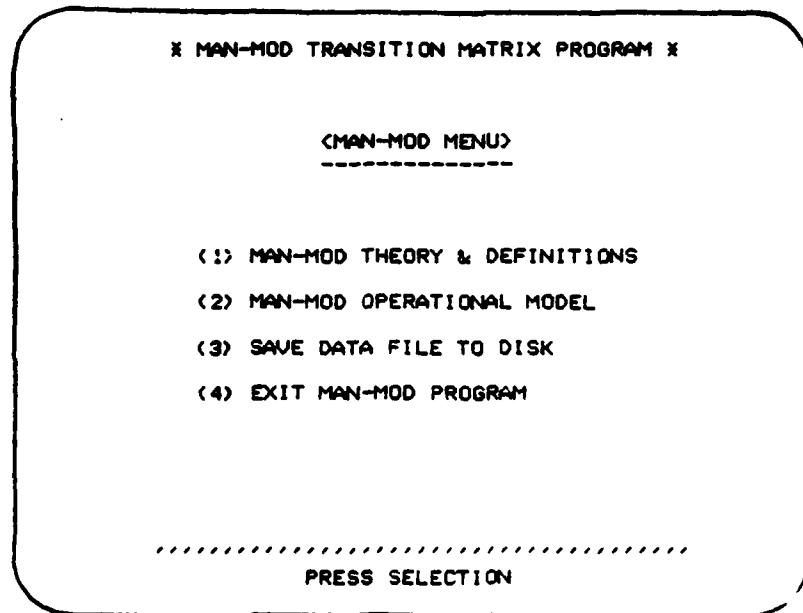
Once the terms have been reviewed, the user presses the key marked RETURN. The screen will go blank for a moment, then this statement will appear:

<MAN-MOD PROGRAM BEING LOADED>

MAIN MENU

It will take approximately 25 seconds for the MAN-MOD/PROGRAM module to load. Once loaded, the MAIN MENU will be

displayed on the screen giving the user several options from which to choose. The user will be able to select the option desired and press the corresponding number. After the option choice is pressed, the program will display the option's menu. The MAIN MENU options are shown in Display 2.

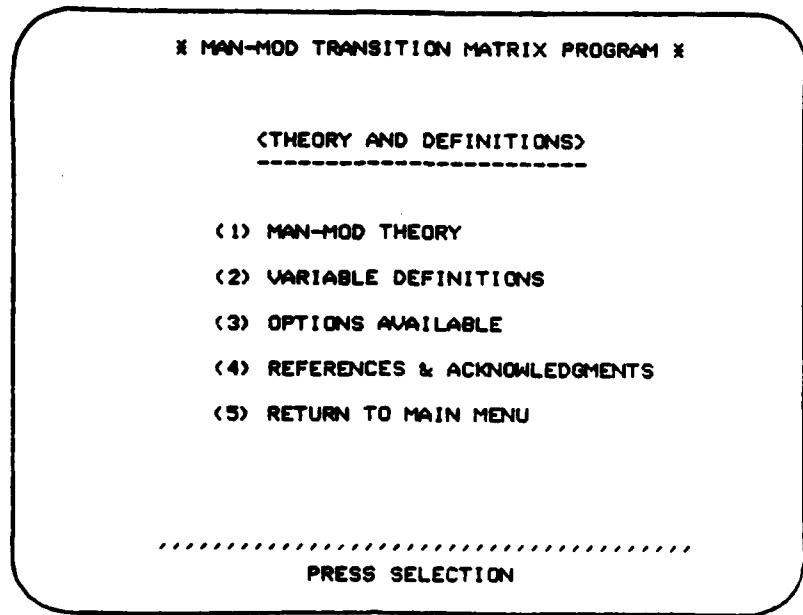


<DISPLAY 2>

MAN-MOD THEORY & DEFINITIONS

Selecting the main menu Option (1), MAN-MOD THEORY & DEFINITIONS, will chain the user to the MAN-MOD/THEORY module. It will take approximately twenty seconds to load the module. Once loaded, a menu will provide the user with choices for a review of the basic Markov chain model, an explanation or definition of variables found in the MAN-MOD program, an overview of options available in performing

the calculations, or major references and acknowledgments. The user may choose a menu option by pressing the desired number. The theory menu is shown in Display 3.



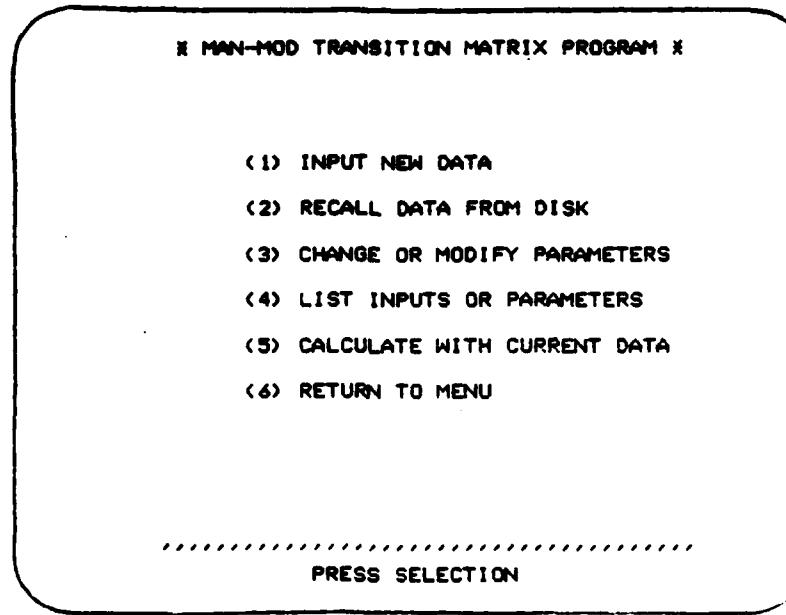
<DISPLAY 3>

Although the Theory and Definitions section will give a basic understanding of MAN-MOD, it is not detailed enough to provide in-depth learning. For users not familiar with Markov chain models, it is recommended that one of the manpower reference books be reviewed. MAN-MOD was programmed on the Apple II to be utilized as a basic forecasting tool for individuals familiar with manpower requirements.

To exit the theory module, the user selects Option (5). The program will then chain the user to the main menu. The main menu is the focal point from which the user selects a working option, see Display 2.

MAN-MOD OPERATIONAL MODEL

Selection (2), MAN-MOD OPERATIONAL MODEL, will place the user in the working program. A menu, Display 4, will be shown on the screen. The user will select a choice and proceed as prompted. The menu options will be discussed in detail to provide the user with a better understanding of the program's capabilities.



<DISPLAY 4>

INPUT NEW DATA

The INPUT NEW DATA, Option (1), allows the user to create a new data file. To create a new file, the user will begin by assigning a FILE NAME. The FILE NAME cannot be over 15 characters in length and must start with a letter of the alphabet. A FILE NAME that begins with a number will be rejected when the save routine is initiated. A

FILE NAME is needed to save the data and recall it at a later time. The user will be prompted on each data entry. After each entry the input will be displayed for verification by the user. The user will have the choice to (R), reenter the data, either correcting or changing the input; to (A), accept the input; or to (E), escape to the MAN-MOD OPERATIONAL MODEL menu, Display 4. The input sequence for new data is as follows:

FILE NAME

NUMBER (K) OF CLASSES OR GRADES

INITIAL CLASS VECTOR (N) (Stocks)

FRACTIONAL FLOW MATRIX (P)

OPTIONS CHOICE (1-5)

RECRUITMENT VECTOR (Options 1-5)

RECRUITMENT NUMBER (Options 2-5)

ADDITIVE NUMBER (Options 2 & 4)

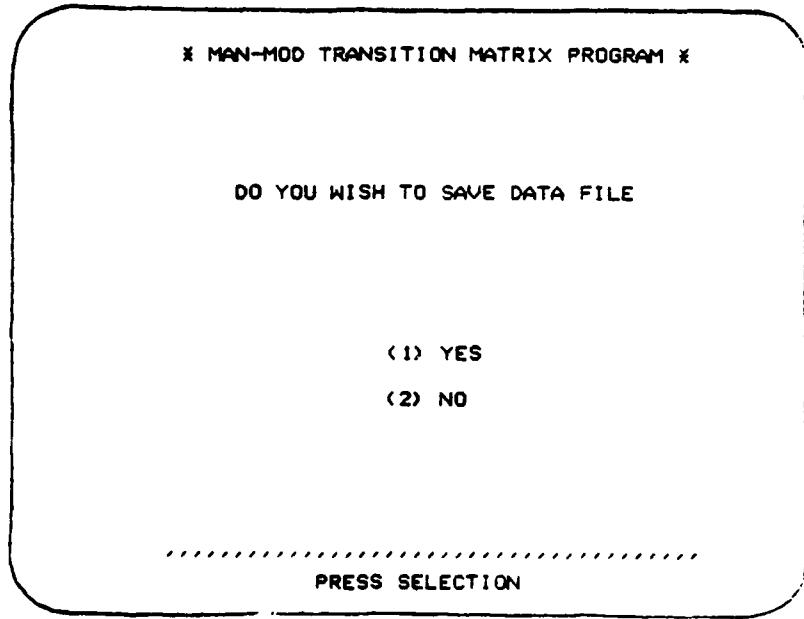
MULTIPLICATIVE FACTOR (Options 3 & 5)

TIME (T) PERIODS TO INITIALLY CALCULATE

PERCENTAGE OPTIONS FOR PRINT OUT

Once the initial input data has been entered, the screen will display "INITIAL INPUTS COMPLETED". The user will then be given the option to save or not to save the data file entered, see Display 5 next page. It is highly recommended, to prevent the loss of data, that the user save the data at this point. If Choice (1), yes, is selected, the screen will state DATA BEING SAVED; the data

will be saved under the entered FILE NAME. Note, if data has been previously saved under this name, it will be erased and the new data saved. Once the data is saved, the program will return the user to the main menu, Display 2. Option (2) will have to be selected to return to the operational model menu. If the user selects 2, NO, not electing to save the input data, he will automatically be returned to the operational model menu, Display 4.



<DISPLAY 5>

The INPUT NEW DATA option allows for a systematic input of data. The input routine sequence corresponds to the suggested input sequence found in the Bartholomew and Forbes' book. The MAN-MOD EXAMPLE shown in the example section illustrates the data a user would input.

RECALL DATA FROM DISK

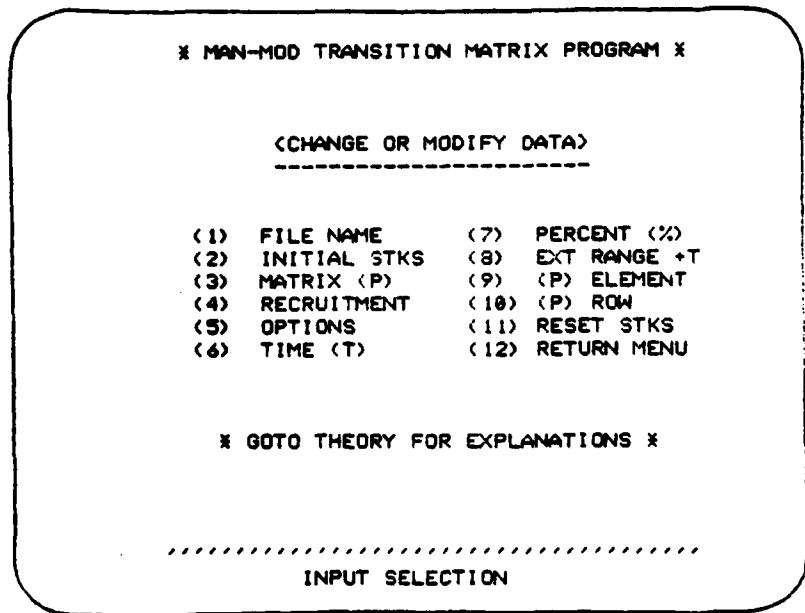
The RECALL DATA FROM DISK, Option (2) of the operational menu, allows the user to recall a data file previously saved under a FILE NAME. The user will be asked to input the FILE NAME he desires to recall. The program will display the file name on the screen and prompt the user to choose either to (A), accept the input FILE NAME and proceed; (R), reenter the name, either correcting the previous entry or inputting a new FILE NAME; or (E), escape from the recall routine to the operational menu.

If a FILE NAME has been entered and accepted for recall, the program will prompt the user as to which disk drive the data file is on. The disk drives are normally labeled Drive 1 and Drive 2. If the drives are not labeled, then the boot drive is Drive 1. The boot drive is the drive which starts up first when the computer is turned on. The user will select the drive in which the data file disk has been placed. The user normally saves his data files on the MAN-MOD program disk and uses only Drive 1. If, while entering the recall information, a mistake is made, the program will prompt the user to <REVERIFY> data entered, FILE NAME and disk drive. If the user is uncertain of the FILE NAME under which he saved his data, he may catalog the disk to verify the name. To catalog the MAN-MOD disk, see the CATALOG section.

Once the FILE NAME is entered and the disk drive has been selected, the program will indicate on the screen that the data file is being loaded. After the file has been loaded, the user will be returned to the operational menu. An illustration of data recall is shown in the example section.

CHANGE OR MODIFY PARAMETERS

Option (3) of the operational menu, Display 4, is the CHANGE OR MODIFY PARAMETERS routine. It is important in that it allows the user the flexibility to modify previously entered or recalled data, and to observe outcomes. The option is menu driven, Display 6.



<DISPLAY 6>

The user will choose the desired parameter he wishes to modify, a number selection, and press the return key.

The program will display the data that has been previously entered and query the user as to his desires. The user may (A), accept data as is and be returned to the menu, or he may press (R) which allows him to reenter that particular data. Once the new data is input, it will be displayed again for an (A), accept, or an (R), reenter user input. Definitions of the menu variables are given in the Theory and Definitions option in the MAN-MOD program.

Once an input is changed or modified, it will remain changed or modified. The user may elect to save the modified data under a new FILE NAME, or the one currently being used. If data has been recalled or previously saved using this FILE NAME, saving the new data under this name will destroy all data previously saved with this name.

The change or modify routine is a powerful means of exploring or examining different scenarios affecting man-power requirements.

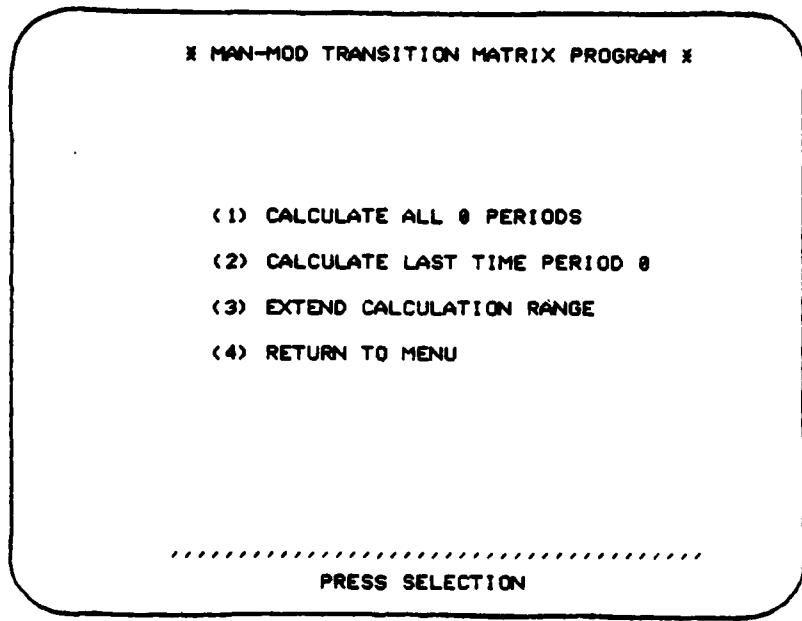
LIST INPUTS OR PARAMETERS

The LIST INPUTS OR PARAMETERS, Option (4) of the operational menu, allows the user to review data in memory, either on the screen or by a paper print out. The user may select this option, as any option, at any time. Due to the number of inputs and the limited 40 column, 24 line display of the Apple II, the screen review will be shown in pages. All matrix inputs and row vectors will be listed in column format. The paper copy will list all data on one page in

normal row format. Examples of data listings are shown in the example section.

CALCULATE WITH CURRENT DATA

The last operational menu choice is Option (5), CALCULATE WITH CURRENT DATA. This option will display three choices. The choices will permit either step calculation, point calculation, or continue calculation - extending the range on data and options presently selected in memory. The option choices are shown in Display 7.



<DISPLAY 7>

Calculations from a selected menu choice may be either displayed on the screen or sent to the printer for a paper copy. The user will be prompted after choosing the desired calculation as to the desired display.

By choosing calculation option 1 or 2, the MAN-MOD program will automatically reset stocks or class sizes to the original memory input and commence calculating from time period (0). Only option 3, extend calculation range, will permit the user to continue from a previously calculated time period done with option 1, 2, or 3.

An advantage in utilizing the extended range choice is, the user may calculate manpower requirements under one set of parameters to a certain time period, go to the CHANGE OR MODIFY menu and change parameters in memory, then continue calculations to a new time period with the new parameters. This would permit the user to consider future changes in recruitment policy, transitioning policy, or any policy affecting the system.

The last choice on any sub-menu will return the user to the next higher menu. Exiting the calculation menu will return the user to the operational menu. The last choice of the operational menu, Display 4, is to return the user to the main menu, which brings the user to the two remaining options to be discussed, SAVE DATA FILE TO DISK and EXIT MAN-MOD PROGRAM.

SAVE DATA FILE TO DISK

Option (3) of the main menu, SAVE DATA FILE TO DISK, provides the user a chance to save data input in memory before exiting the program or continuing on to another option. A save option is automatically provided ending the

INPUT NEW DATA routine. However, if data has been modified or the input data has not been saved and the user wishes to save it now, he may do so by selecting Option (3). The option will prompt the user as to FILE NAME to be saved and disk drive choice. An explanation of disk drives is discussed in the RECALL DATA FROM DISK section. Note, using previously saved FILE NAME could cause loss of previously saved data.

Once the user has responded to prompts and the data file has been saved, the program will return the user to the main menu.

EXIT MAN-MOD PROGRAM

Option (4), EXIT MAN-MOD PROGRAM, of the main menu will terminate the MAN-MOD program. Selecting this option will display the exit menu giving the user a last opportunity to return to the main menu before terminating. If EXIT PROGRAM is selected, the program will be terminated displaying an exit statement; all data in memory is lost.

ERROR RECOVERY

MAN-MOD was written to be robust and to protect the user from errors and program problems. However, Murphy's Law will always prevail, and if an error or program problem can happen, it will.

Rule 1, always save data first. It is best to do so as soon as possible. If an unrecoverable error occurs,

then the data is safe on a storage disk and the program can be restarted or reinitialized.

One of the most common inadvertent errors a user may make is to press the RESET key. Once pressed, the RESET key will cause a program interruption and place the user in Applesoft basic, indicated by a bracket on the screen and a flashing cursor. All data in memory will be lost. However, the user may reenter the MAN-MOD program by typing RUN, see Display 8, and pressing the return key, or by reinitializing the MAN-MOD PROGRAM.

CATALOG

DISK VOLUME 254

XA 007 MAN-MOD/HELLO
XB 004 MAN-MOD/FORMATTER
XB 003 MAN-MOD/LINKER
XA 100 MAN-MOD/PROGRAM
XA 067 MAN-MOD/THEORY
T 002 MAN-MOD EXAMPLE

JRUN

<DISPLAY 8>

The user may reinitialize the MAN-MOD program two ways; first, by typing PR#6 and pressing the return key, or second, by turning the computer off and back on. The first method is preferred.

Program interruptions will occur. The best recommended restart is to reinitialize the program. Restarting the program with RUN could possibly work, but unless the user has an idea of why the program was interrupted, it is best to clear memory and reload by initializing.

CATALOG

Sooner or later the user will desire to see or verify the data file names he has saved to the disk. At present the MAN-MOD program does not provide an internal review capability. The capability does exist for the user to list the files on a standard Apple II Disk Operating System (DOS) disk from Applesoft basic. To CATALOG the disk or list the programs saved, the user must enter Applesoft basic. There are two ways to accomplish this, one is to press the RESET key, the other is to exit the program.

Pressing the RESET key will cause a program interruption and place the user in Applesoft basic. Since pressing the reset key inadvertently is not desired, Apple computer designers modified later Apple II's to give the owner a capability to disable the normal RESET function. The modification provides an internal switch within the computer, causing the RESET key function to work only in conjunction with the CONTROL key. The user must determine in which mode the system is configured. If pressing the RESET key does not interrupt the program, then try pressing the

CONTROL key and the RESET key simultaneously. One of the operations will place the user in Applesoft basic.

The other means of entering Applesoft basic is to use the EXIT MAN-MOD PROGRAM main menu option (4). This will clear the screen and place the user in Applesoft basic with a bracket and flashing cursor in the upper left corner.

Once in Applesoft basic, the user can type CATALOG and press the return key. The disk drive will initialize and all programs saved on the disk in the initializing drive will be listed on the screen, see Display 8, preceding page. If the list is longer than the screen listing capability, it will pause allowing the user to review the first part of the catalog, pressing the return key will continue the listing. Once the programs have been listed, the bracket and flashing cursor will reappear. After reviewing the CATALOG, the user may reenter the MAN-MOD program by reinitializing the program or by typing RUN and pressing the return key. To reinitialize the program, the user may type PR#6 and press return, or turn the computer off and back on. It is recommended that the user reinitialize the program to reenter. The reinitialization will take longer, approximately 30 seconds, but will clear and reload memory preventing any inadvertent memory changes which might cause program interruptions or erroneous calculations. The preferred method is typing PR#6.

DISK MAINTENANCE

The 5 1/4 inch storage disk is referred to as a "floppy" disk. MAN-MOD has been programmed and stored on a floppy disk for the user's convenience. The storage is done magnetically, similarly to storing music on a magnetic tape. The magnetic floppy disk is durable but not indestructable. The same care and concern one would give a musical tape recording should be given to a floppy storage disk. The disks are susceptible to heat, magnetic fields, and physical abuse. Any one of the three could cause total or partial loss of the MAN-MOD programs or saved data files. If data is lost or damage occurs, return the disk to the issuer. BACKUP copies of data files may be made by using the SAVE DATA TO DISK main menu option and saving the file to a second disk.

BACKUP

BACKUP is a reference term, pertaining to the saving of a second copy of a program or data file. MAN-MOD has the capability through the SAVE DATA TO DISK option to save a second copy. To utilize this capability, the user must have two disks, MAN-MOD and an initialized floppy disk or a second MAN-MOD disk. An initialized second disk may be obtained by purchasing a blank disk and asking an Apple owner to initialize it. With a BACKUP copy, if the original MAN-MOD disk is damaged, destroyed, or lost, the user will have backup data files and not all will be lost.

MAN-MOD EXAMPLE

The following example is an illustration of data input, a listing of that data, and a calculation routine performed on the data using a pre-selected calculation option, Additive (System Size). The example is called "MAN-MOD EXAMPLE". The example has been entered and stored on the MAN-MOD program disk. The user may recall the data file and experiment with various options, or may reenter the data under a new FILE NAME to simulate similar operations. MAN-MOD EXAMPLE will give the user an idea of what the input data listing will look like and an example of both a step calculation and a point calculation printout. Illustrations are found on the following pages.

In selecting a listing or calculations display, the user may choose either a screen display or a paper copy. The MAN-MOD program will not at present give both displays simultaneously. The user may utilize the screen display for manipulating calculations and once the desired output is attained, recalculate the same parameters to a paper copy.

The following are illustrations of data input, listings, and calculations. The input is for the MAN-MOD EXAMPLE. If further illustrations are desired, the Bartholomew and Forbes' book is recommended. MAN-MOD is an adaptation of those authors' BASEQN model.

MAN-MOD EXAMPLE DATA INPUT

FILE NAME: MAN-MOD EXAMPLE

NUMBER (K) CLASSES: 3

INITIAL STOCK VECTOR: R1 *

| | |
|----|----|
| C1 | 70 |
| C2 | 20 |
| C3 | 10 |

MATRIX (P: R1 R2 R3 *

| | | | |
|----|-----|-----|-----|
| C1 | .95 | .00 | .00 |
| C2 | .01 | .94 | .00 |
| C3 | .00 | .00 | .95 |

OPTION: (4) ADDITIVE (SYSTEM SIZE)

RECRUITMENT VECTOR: R1 *

| | |
|----|-----|
| C1 | .70 |
| C2 | .20 |
| C3 | .10 |

RECRUITMENT NUMBER: NOT REQUIRED

ADDITIVE NUMBER: 10

MULTIPLICATIVE FACTOR: Options 3 & 5 only

TIME (T) PERIODS: 5

PERCENTAGE OPTION: (2) PRESENT PERIOD

* INPUT OF ROW VECTORS IS VERTICAL

INPUT DATA LIST

ILLUSTRATION 1

MAN-MOD EXAMPLE DATA LISTING

----- MAN-MOD DATA FILE LISTING -----

DATA FILE NAME IS....: MAN-MOD EXAMPLE
NUMBER (K) CLASSES...: (3)
TIME (T) PERIODS....: (5)
PERCENTAGES OPTION...: GRADE SIZE AS % OF TOTAL SIZE
OPTION SELECTED IS...: ADDITIVE (SYSTEM SIZE)
OPTION INPUTS.....: CALCULATES TOTAL NET NUMBER
TO INCREASE SYSTEM BY (10)

INITIAL STOCK (N) VECTOR AND RECRUITMENT (R) VECTOR

| | COL 1 | COL 2 | COL 3 |
|------------|-------|-------|-------|
| VECTOR N: | 70 | 20 | 10 |
| RECRUIT R: | .7000 | .2000 | .1000 |

TRANSITIONAL FLOW MATRIX (P)

| | COL 1 | COL 2 | COL 3 |
|---------|-------|-------|-------|
| ROW (1) | .9500 | .0100 | .0000 |
| ROW (2) | .0000 | .9400 | .0000 |
| ROW (3) | .0000 | .0000 | .9500 |

INPUT DATA LISTING

ILLUSTRATION 2

MAN-MOD EXAMPLE, STEP & POINT CALCULATIONS

DATA FILE NAME...: (MAN-MOD EXAMPLE)

TRANSITIONAL FLOWS

| TIME | CLASS | STOCKS (N) | (PERCENT) | RECRUITMENT |
|-------|-------|------------|-----------|-------------|
| 0 | 1 | 70 | (70) | 0 |
| | 2 | 20 | (20) | 0 |
| | 3 | 10 | (10) | 0 |
| TOTAL | | 100 | (100) | |
| 1 | 1 | 77 | (70) | 10 |
| | 2 | 22 | (20) | 3 |
| | 3 | 11 | (10) | 1 |
| TOTAL | | 110 | (110) | 15 |
| 2 | 1 | 83 | (69) | 10 |
| | 2 | 25 | (21) | 3 |
| | 3 | 12 | (10) | 1 |
| TOTAL | | 120 | (120) | 15 |
| 3 | 1 | 90 | (69) | 11 |
| | 2 | 27 | (21) | 3 |
| | 3 | 13 | (10) | 2 |
| TOTAL | | 130 | (130) | 15 |
| 4 | 1 | 97 | (69) | 11 |
| | 2 | 30 | (21) | 3 |
| | 3 | 14 | (10) | 2 |
| TOTAL | | 140 | (140) | 16 |
| 5 | 1 | 103 | (69) | 11 |
| | 2 | 32 | (21) | 3 |
| | 3 | 15 | (10) | 2 |
| TOTAL | | 150 | (150) | 16 |

DATA FILE NAME...: (MAN-MOD EXAMPLE)

TRANSITIONAL FLOWS

| TIME | CLASS | STOCKS (N) | (PERCENT) | RECRUITMENT |
|-------|-------|------------|-----------|-------------|
| 5 | 1 | 103 | (69) | 11 |
| | 2 | 32 | (21) | 3 |
| | 3 | 15 | (10) | 2 |
| TOTAL | | 150 | (150) | 16 |

ILLUSTRATION 3

PROGRAM ACCURACY

The MAN-MOD program's accuracy is determined by the limitations of Applesoft basic. The format is based on "real precision" or "floating point" numbers. MAN-MOD will calculate stocks for display or printout to 999999, any number greater will result in a >>>> display. Percentages greater than 999 will result in a >>> display. Since the MAN-MOD program primarily is concerned with stocks, no fractions are listed. MAN-MOD uses an integer .5 round off routine for both class stocks and total listings. Thus, a difference may occur.

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APPENDIX A

MAN-MOD/HELLO MODULE PROGRAM LISTING

The MAN-MOD/HELLO module is written in Apple II Applesoft basic. The program was listed using XLISTER, a Beagle Brothers Inc. program.

MAN-MOD/HELLO (PROGRAM LISTING)

```
1000 REM      MAN-MOD/HELLO PROGRAM
-----
1002 D$ = CHR$(4)
: Q$ = CHR$(34)
: REM  CTRL=D & "
-----
1004 HOME
: VTAB 9
: HTAB 13
: PRINT "MAN-MOD PROGRAM"
: VTAB 11
: HTAB 16
: PRINT "MARCH 1982"
: VTAB 13
: HTAB 8
: PRINT "NAVAL POSTGRADUATE SCHOOL"
: VTAB 15
: HTAB 12
: PRINT "THESIS REQUIREMENT"
: FOR I = 1 TO 2500
: NEXT
-----
1006 TEXT
: HOME
: VTAB 1
: HTAB 1
: INVERSE
: PRINT " * MAN-MOD TRANSITION MATRIX PROGRAM * "
: NORMAL
-----
1008 VTAB 23
: HTAB 1
: FOR I = 1 TO 39
: PRINT "'";
: NEXT
-----
1010 SPEED= 100
-----
1012 VTAB 8
: HTAB 15
: PRINT "MAN-MOD IS"
: PRINT
: HTAB 9
: PRINT "AN APPLE ADAPTATION OF"
: PRINT
: HTAB 9
: PRINT "BARTHOLOMEW AND FORBES'"
```

```
: PRINT
: HTAB 2
: PRINT Q$"BASEQN"Q$" - A MARKOV TRANSITION MODEL"
-----
1014 SPEED= 255
: FOR I = 1 TO 1500
: NEXT I
-----
1016 TEXT
: HOME
: VTAB 1
: HTAB 1
: INVERSE
: PRINT " * MAN-MOD TRANSITION MATRIX PROGRAM * "
: NORMAL
-----
1018 VTAB 4
: HTAB 11
: PRINT "<TERMINOLOGY REVIEW>"
: HTAB 11
: PRINT "-----"
-----
1020 VTAB 7
: HTAB 1
: INVERSE
: PRINT "(A) ACCEPT:";
: NORMAL
: HTAB 14
: PRINT "ACCEPT SCREEN DISPLAY, PRO-"
: VTAB 8
: HTAB 14
: PRINT "CEED TO NEXT ROUTINE"
-----
1022 VTAB 10
: HTAB 1
: INVERSE
: PRINT "(E) ESCAPE:";
: NORMAL
: HTAB 14
: PRINT "ABORT PRESENT ROUTINE, RE-"
: HTAB 14
: PRINT "TURN TO MENU"
-----
1024 VTAB 13
: HTAB 1
: INVERSE
: PRINT "INPUT:";
: NORMAL
: HTAB 14
: PRINT "CALLS FOR A DATA INPUT,"
```

```
: HTAB 14
: PRINT "ONCE ENTERED PRESS RETURN"
-----
1026  VTAB 16
: HTAB 1
: INVERSE
: PRINT "PRESS:";
: NORMAL
: HTAB 14
: PRINT "SELECT CHOICE OF SCREEN OP-"
: VTAB 17
: HTAB 14
: PRINT "TIONS, AND PRESS CHOICE"
-----
1028  VTAB 19
: HTAB 1
: INVERSE
: PRINT "(R) REENTER:";
: NORMAL
: HTAB 14
: PRINT "RE-INPUT VALUES DISPLAYED"
: VTAB 20
: HTAB 14
: PRINT "ON SCREEN"
-----
1030  VTAB 23
: HTAB 1
: FOR I = 1 TO 39
: PRINT "'";
: NEXT
-----
1032  VTAB 24
: HTAB 7
: PRINT "PRESS RETURN TO CONTINUE ";
: GET G$
-----
2000  DIM N(9)
: REM      INITIAL CLASS VECTOR
-----
2002  DIM P(9,9)
: REM      TRANSITION MATRIX FLOW RATES
-----
2004  DIM R(9)
: REM      INFLOW SPECIFICATION AND OPTION
-----
2006  DIM X(9)
: REM      TEMPORARY MATRIX VECTOR
-----
2008  DIM Q(9)
: REM      NEW TRANSITION MATRIX
```

```
-----  
3000 TEXT  
: HOME  
: VTAB 11  
: HTAB 5  
: PRINT "<MAN-MOD PROGRAM BEING LOADED>"  
-----  
3002 PRINT D$;"BRUN MAN-MOD/FORMATTER"  
-----  
3004 PRINT D$;"BLOAD MAN-MOD/LINKER, A520"  
-----  
3006 CALL 520"MAN-MOD/PROGRAM"
```

APPENDIX B

MAN-MOD/THEORY MODULE

PROGRAM LISTING

The MAN-MOD/THEORY module is written in Apple II Applesoft basic. The program was listed using XLISTER, a Beagle Brothers Inc. program.

MAN-MOD/THEORY (PROGRAM LISTING)

```
-----  
1000  D$ = CHR$(4)  
      : REM   CTRL-D  
-----  
1002  REM  MAN-MOD/INTRODUCTION PROGRAM  
-----  
1004  GOSUB 9000  
-----  
1006  VTAB 5  
      : HTAB 8  
      : PRINT "<THEORY AND DEFINITIONS>"  
      : HTAB 8  
      : PRINT "-----"  
-----  
1008  VTAB 9  
      : HTAB 5  
      : PRINT "(1) MAN-MOD THEORY"  
      : PRINT  
-----  
1010  HTAB 5  
      : PRINT "(2) VARIABLE DEFINITIONS"  
      : PRINT  
-----  
1012  HTAB 5  
      : PRINT "(3) OPTIONS AVAILABLE"  
      : PRINT  
-----  
1014  HTAB 5  
      : PRINT "(4) REFERENCES & ACKNOWLEDGMENTS"  
      : PRINT  
-----  
1016  HTAB 5  
      : PRINT "(5) RETURN TO MAIN MENU"  
      : PRINT  
-----  
1018  GOSUB 9100  
-----  
1020  IF G < 1 OR G > 5 THEN 1018  
-----  
1022  ON G GOTO 2000,3000,4000,5000,6000  
-----  
2000  GOSUB 9000  
-----  
2002  VTAB 3  
      : HTAB 13  
      : PRINT "MAN-MOD THEORY"  
      : VTAB 6  
      : HTAB 3
```

```

: PRINT "A BASIC EXPLANANTION OF A MARKOV CHAIN"
: VTAB 8
: PRINT "MODEL IS NEEDED TO UNDERSTAND MAN-MOD. A"
: VTAB 10
: PRINT "MARKOV CHAIN MODEL ASSUMES THAT AN IN-"
-----
2004  VTAB 12
: PRINT "DIVIDUAL WILL MOVE INDEPENDENTLY FROM"
: VTAB 14
: PRINT "ONE CLASS TO ANOTHER. INDIVIDUAL MOVES"
: VTAB 16
: PRINT "ARE ACCOMPLISHED WITH TRANSITION PROBA-"
-----
2006  VTAB 18
: PRINT "BILITIES THAT DO NOT VARY OVER TIME. THE"
: VTAB 20
: PRINT "TRANSITION PROBABILITIES ARE ARRANGED IN"
: GOSUB 9300
: IF G$ = "M" GOTO 1004
-----
2008  VTAB 3
: HTAB 1
: CALL - 958
: VTAB 4
: PRINT "AN ARRAY KNOWN AS A TRANSITION MATRIX."
: VTAB 6
: PRINT "THE ELEMENTS OF THE ARRAY ARE LABELED AS"
: VTAB 8
: PRINT "FOLLOWS:"
-----
2010  VTAB 11
: HTAB 3
: PRINT "P(1,1) P(1,2) P(1,3),...,P(1,K) W(1)"
: VTAB 13
: HTAB 3
: PRINT "P(2,1) P(2,2),.....,P(2,K) W(2)"
-----
2012  VTAB 15
: HTAB 3
: PRINT "...."
: VTAB 17
: HTAB 3
: PRINT "....."
: VTAB 19
: HTAB 3
: PRINT "P(K,1) P(K,2),.....,P(K,K) W(K)"
: XX = 11
: FOR I = 1 TO 9
:   VTAB (XX)
:   HTAB 1

```

```

: INVERSE
: PRINT " "
: XX = XX + 1
: NEXT
: NORMAL
: GOSUB 9300
: IF G$ = "M" GOTO 1004
-----
2014 VTAB 3
: HTAB 1
: CALL - 958
: VTAB 4
: HTAB 3
: PRINT "THE ELEMENT P(I,J) OF THE ARRAY IS THE"
: VTAB 6
: PRINT "PROBABILITY THAT AN INDIVIDUAL IN CLASS"
: VTAB 8
: PRINT "'I' AT THE BEGINNING OF A TIME INTERVAL"
-----
2016 VTAB 10
: PRINT "WILL MOVE TO CLASS 'J' AT THE END OF"
: VTAB 12
: PRINT "THAT TIME PERIOD. THE AMOUNT W(I) IS"
: VTAB 14
: PRINT "THE PROBABILITY THAT THE INDIVIDUAL IN"
: VTAB 16
: PRINT "CLASS 'I', AT THE START OF AN INTERVAL,"
-----
2018 VTAB 18
: PRINT "HAS LEFT THE SYSTEM BY THE END OF THE "
: VTAB 20
: PRINT "INTERVAL. THE ASSUMPTIONS ARE THAT AN"
: GOSUB 9300
: IF G$ = "M" GOTO 1004
-----
2020 VTAB 3
: HTAB 1
: CALL - 958
: VTAB 4
: PRINT "INDIVIDUAL MUST STAY WHERE HE IS, MOVE"
: VTAB 6
: PRINT "TO ANOTHER CLASS, OR LEAVE. THE SUM OF"
: VTAB 8
: PRINT "PROBABILITIES IN THE CLASS ROW, P(I,1)+"
: VTAB 10
: PRINT "...+ P(I,K) + W(I), MUST EQUAL ONE."
-----
2022 VTAB 12
: HTAB 3
: PRINT "THE MATRIX (P) IS THE MATRIX OF THE"

```

```

: VTAB 14
: PRINT "P(I,J)'S. THE WASTAGE VECTOR (W) IS THE"
: VTAB 16
: PRINT "VECTOR W(1),...,W(K). IT IS IMPLICIT IN"
: VTAB 18
: PRINT "IN MARKOV MODELS THAT TIME PERIODS ARE"
-----
2024 VTAB 20
: PRINT "DISCRETE AND OF EQUAL DURATION."
: GOSUB 9300
: IF G$ = "M" GOTO 1004
-----
2026 VTAB 3
: HTAB 1
: CALL - 958
: VTAB 4
: HTAB 3
: PRINT "THE FINAL INPUT IS RECRUITMENT. THE"
: VTAB 6
: PRINT "RECRUITMENT VECTOR DESCRIBES THE NUMBER"
: VTAB 8
: PRINT "OF INDIVIDUALS THAT WILL REPLENISH THE"
-----
2028 VTAB 10
: PRINT "CLASSES EACH PERIOD. THE TOTAL RECRUIT-"
: VTAB 12
: PRINT "MENT IS REFERRED TO AS R, AND IS THE SUM"
: VTAB 14
: PRINT "OF THE ELEMENTS OF THE RECRUITMENT VEC-"
: VTAB 16
: PRINT "TOR R(1),...,R(K). THE RECRUITMENT VECTOR"
-----
2030 VTAB 18
: PRINT "CAN BE EXPRESSED BY EITHER INTEGER NUM-"
: VTAB 20
: PRINT "BERS THAT AUGMENT THE CLASSES OR BY PRO-"
: GOSUB 9300
: IF G$ = "M" GOTO 1100
-----
2032 VTAB 3
: HTAB 1
: CALL - 958
: VTAB 4
: PRINT "PORTIONS, THAT ADD TO ONE, OF A TOTAL"
: VTAB 6
: PRINT "RECRUITMENT."
: VTAB 8
: HTAB 3
: PRINT "THE MARKOV CHAIN MODEL, MAN-MOD, AL-"
-----

```

```
2034  VTAB 10
: PRINT "LOWS THE USER TO ANALYZE INTERCONNECTED"
: VTAB 12
: PRINT "STOCKS AND FLOWS FROM ASSUMPTIONS ABOUT"
: VTAB 14
: PRINT "INDIVIDUAL CLASS TRANSITIONS AND TO VARY"
: VTAB 16
: PRINT "THE PROBABILITIES THAT AFFECT TRANSI-"
-----
2036  VTAB 18
: PRINT "TIONING. FOR A MORE DETAILED EXPLANATION"
: VTAB 20
: PRINT "OF MARKOV THEORY, BARTHOLOMEW AND FORBES"
: GOSUB 9300
: IF G$ = "M" GOTO 1004
-----
2038  VTAB 3
: HTAB 1
: CALL - 958
: VTAB 4
: PRINT "BOOK, " CHR$ (34)"STATISTICAL TECHNIQUES FO
      R MAN-"
: VTAB 6
: PRINT "POWER PLANNING" CHR$ (34)", IS RECOMMENDED."
-----
2040  GOSUB 9200
-----
2042  GOTO 1004
-----
3000  GOSUB 9000
-----
3002  VTAB 4
: HTAB 10
: PRINT "VARIABLES DEFINITIONS"
-----
3004  VTAB 7
: HTAB 3
: PRINT "(1) FILE NAME";
: HTAB 23
: PRINT "(7) PERCENT (%)"
: VTAB 9
: HTAB 3
: PRINT "(2) INITIAL STKS";
: HTAB 23
: PRINT "(8) INC TIME"
: VTAB 11
: HTAB 3
: PRINT "(3) MATRIX (P)";
: HTAB 23
: PRINT "(9) (P) ELEMENT"
```

```
-----  
3006  VTAB 13  
: HTAB 3  
: PRINT "(4) RECRUITMENT";  
: HTAB 23  
: PRINT "(10) (P) ROW"  
: VTAB 15  
: HTAB 3  
: PRINT "(5) OPTIONS";  
: HTAB 23  
: PRINT "(11) RESET STKS"  
: VTAB 17  
: HTAB 3  
: PRINT "(6) TIME (T)";  
: HTAB 23  
: PRINT "(12) RETURN MENU"  
-----  
3008  VTAB 23  
: HTAB 1  
: FOR I = 1 TO 39  
: PRINT ":";  
: NEXT  
: VTAB 24  
: HTAB 11  
: PRINT "INPUT SELECTION ";  
: INPUT G$  
: G = VAL (G$)  
-----  
3010  IF G < 1 OR G > 12 GOTO 3000  
-----  
3012  ON G GOTO 3060,3120,3180,3240,3300,3360,3420,3480,35  
      40,3600,3660,1004  
-----  
3060  GOSUB 9000  
: VTAB 3  
: HTAB 16  
: PRINT "FILE NAME"  
: VTAB 6  
: HTAB 3  
: PRINT "FILE NAME IS A MAXIMUM 15 CHARACTER"  
: VTAB 8  
: PRINT "NAME ASSIGNED TO THE DATA INPUT. THE IN-"  
: VTAB 10  
: PRINT "PUT DATA MAY BE SAVED WITH THIS NAME TO"  
:  
-----  
3062  VTAB 12  
: PRINT "A DISK. IF THE DATA INPUT IS CHANGED OR"  
: VTAB 14  
: PRINT "MODIFIED, THE FILE NAME MAY BE CHANGED"
```

```

: VTAB 16
: PRINT "TO SAVE THE REVISED DATA WITHOUT DES-"
-----
3064 VTAB 18
: PRINT "TRYING THE PREVIOUSLY SAVED DATA."
: GOSUB 9200
: GOTO 3000
-----
3120 GOSUB 9000
: VTAB 3
: HTAB 15
: PRINT "INITIAL STKS"
: VTAB 6
: HTAB 3
: PRINT "THE INITIAL STOCKS REPRESENT THE ORIG-"
: VTAB 8
: PRINT "INAL GRADE OR CLASS 'I' SIZES. K IS THE"
: VTAB 10
: PRINT "NUMBER OF CLASSES. THE INITIAL STOCKS"
-----
3122 VTAB 12
: PRINT "ARE THOSE WITHIN THE SYSTEM AT TIME PER-"
: VTAB 14
: PRINT "IOD ZERO, (0). THE STOCKS ARE ENTERED AS"
: VTAB 16
: PRINT "A ROW VECTOR (N) WITH COMPONENTS: N(1),."
-----
3124 VTAB 18
: PRINT "...,N(K). MAN-MOD'S PROGRAM INPUT PROMPT"
: VTAB 20
: PRINT "FOR STOCK VECTOR (N) IS R1 FOR ROW 1 AND"
: GOSUB 9300
: IF G$ = "M" GOTO 3000
-----
3126 GOSUB 9000
: VTAB 4
: PRINT "C1 FOR COLUMN 1. TO INPUT STOCK N(1),"
: VTAB 6
: PRINT "THE USER WOULD RESPOND TO (R1,C1:?) BY"
: VTAB 8
: PRINT "INPUTTING THE N(1) STOCK COMPONENT. THE"
: VTAB 10
: PRINT "USER WOULD INPUT N(2) IN RESPONSE TO THE"
-----
3128 VTAB 12
: PRINT "(R1,C2:?) PROMPT. CLASS STOCKS ARE INPUT"
: VTAB 14
: PRINT "UNTIL 'K' STOCKS HAVE BEEN REACHED. K IS"
: VTAB 16
: PRINT "THE NUMBER OF CLASSES IN THE SYSTEM."

```

```
: GOSUB 9200
: GOTO 3000
-----
3130 GOSUB 9200
: GOTO 3000
-----
3180 GOSUB 9000
: VTAB 3
: HTAB 16
: PRINT "MATRIX (P)"
: VTAB 6
: HTAB 3
: PRINT "MATRIX (P) SUMMARIZES THE TRANSITIONAL"
: VTAB 8
: PRINT "FLOWS OF STOCKS WITHIN THE SYSTEM. THE"
: VTAB 10
: PRINT "FLOWS ARE LISTED IN A (K X K) MATRIX, K"
-----
3182 VTAB 12
: PRINT "BEING LIMITED TO 9 CLASSES. EACH CLASS"
: VTAB 14
: PRINT "VECTOR REPRESENTS FLOW RATES FROM THAT"
: VTAB 16
: PRINT "CLASS. THE RESPONSE TO THE PROMPT R(I),"
-----
3184 VTAB 18
: PRINT "C(J) SHOULD BE THE FLOW RATE P(I,J) FROM"
: VTAB 20
: PRINT "CLASS 'I' TO CLASS 'J'."
: GOSUB 9200
: GOTO 3000
-----
3240 GOSUB 9000
: VTAB 3
: HTAB 16
: PRINT "RECRUITMENT"
: VTAB 6
: HTAB 3
: PRINT "RECRUITMENT 'R' IS THE NUMBER OF INDIVIDUALS"
: VTAB 8
: PRINT "ENTERING THE SYSTEM. THE SYSTEM"
: VTAB 10
: PRINT "IS NORMALLY MAINTAINED AT A STEADY STATE"
-----
3242 VTAB 12
: PRINT "THROUGH RECRUITMENT. FLUCTUATION IN RECRUITMENT WILL CAUSE A SYSTEM TO CHANGE"
: VTAB 14
: PRINT "RECRUITMENT WILL CAUSE A SYSTEM TO CHANGE"
: VTAB 16
: PRINT "IN SIZE. MAN-MOD RECRUITMENT INPUTS VARY"
```

```
-----  
3244  VTAB 18  
: PRINT "WITH THE CALCULATION OPTION CHOICE.  IN"  
: VTAB 20  
: PRINT "THE FIXED RECRUITMENT VECTOR, THE ACTUAL"  
: GOSUB 9300  
: IF GS = "M" GOTO 3000  
-----  
3246  GOSUB 9000  
: VTAB 4  
: PRINT "NUMBER ENTERING EACH CLASS 'I' IS INPUT,"  
: VTAB 6  
: PRINT "I.E. (70, 20, 10); RECRUITMENT 100.  IN"  
: VTAB 8  
: PRINT "THE OTHER OPTIONS, 2 - 5, RECRUITMENT IS"  
-----  
3248  VTAB 10  
: PRINT "A WHOLE NUMBER, I.E. 100, AND IS DISTRI-"  
: VTAB 12  
: PRINT "BUTED WITHIN THE SYSTEM BY AN HISTORICAL"  
: VTAB 14  
: PRINT "PROPORTION VECTOR, E.G. (.70, .20, .10)."  
-----  
3250  VTAB 16  
: PRINT "THE USER WILL BE PROMPTED BY THE APPRO-"  
: VTAB 18  
: PRINT "PRIATE INPUT COMMANDS.  THE PROGRAM AL-"  
: VTAB 20  
: PRINT "LOWS FOR GROWTH OR DECAY,  DEPENDING ON"  
: GOSUB 9300  
: IF GS = "M" GOTO 3000  
-----  
3252  GOSUB 9000  
: VTAB 4  
: PRINT "THE USER INPUT.  OPTIONS 2 - 5 WILL ASK"  
: VTAB 6  
: PRINT "FOR AN ADDITIVE NUMBER OR A MULTIPLICA-"  
: VTAB 8  
: PRINT "TIVE FACTOR TO ACCOMPLISH THIS.  THE USER"  
-----  
3254  VTAB 10  
: PRINT "WILL INPUT THE DESIRED SYSTEM GROWTH OR"  
: VTAB 12  
: PRINT "CONTRACTION."  
: GOSUB 9200  
: GOTO 3000  
-----  
3300  GOSUB 9000  
: VTAB 3  
: HTAB 18
```

```
: PRINT "OPTIONS"
: VTAB 6
: HTAB 4
: PRINT "OPTIONS 1 - 5 ALLOW THE MAN-MOD USER"
: VTAB 8
: PRINT "TO MANIPULATE DATA ENTERED. THE EFFECTS"
-----
3302  VTAB 10
: PRINT "OF DIFFERENT TRANSITIONS AND FLOW RATES"
: VTAB 12
: PRINT "CAN BE OBSERVED. AN EXPLANATION OF EACH"
: VTAB 14
: PRINT "OPTION IS OBTAINED BY SELECTING THE MENU"
-----
3304  VTAB 16
: PRINT "CHOICE, OPTIONS AVAILABLE."
: GOSUB 9200
: GOTO 3000
-----
3360  GOSUB 9000
: VTAB 3
: HTAB 17
: PRINT "TIME (T)"
: VTAB 6
: HTAB 4
: PRINT "TIME (T) IS A USER INPUT TO THE MAN-"
: VTAB 8
: PRINT "MOD PROGRAM. IT DETERMINES THE NUMBER OF"
: VTAB 10
: PRINT "PERIODS FOR WHICH CALCULATIONS ARE TO BE"
-----
3362  VTAB 12
: PRINT "PERFORMED. CALCULATIONS MAY BE DONE RE-"
: VTAB 14
: PRINT "PEATEDLY, AND CHANGES OR MODIFICATIONS"
: VTAB 16
: PRINT "TO PARAMETERS CAN BE IMPLEMENTED THROUGH"
-----
3364  VTAB 18
: PRINT "THE MAIN MENU. THE USER MAY INCREASE THE"
: VTAB 20
: PRINT "NUMBER OF PERIODS EITHER BY USING 'TIME"
: GOSUB 9300
: IF G$ = "M" GOTO 3000
-----
3366  GOSUB 9000
: VTAB 4
: PRINT "(T)' OR THE 'EXT RANGE +T' CHOICE ON THE"
: VTAB 6
: PRINT "THE CHANGE OR MODIFY MENU. TIME PERIOD"
```

```
: VTAB 8
: PRINT "ZERO (0) IS THE INITIAL PERIOD; PERIOD"
-----
3368 VTAB 10
: PRINT "ONE (1) IS ONE TIME PERIOD LATER."
: GOSUB 9200
: GOTO 3000
-----
3420 GOSUB 9000
: VTAB 3
: HTAB 16
: PRINT "PERCENT (%)"
: VTAB 6
: HTAB 3
: PRINT "PERCENT (%) IS AN OPTION SELECTION DE-"
: VTAB 8
: PRINT "TERMINED BY THE MAN-MOD USER. IT AFFECTS"
-----
3422 VTAB 10
: PRINT "ONLY THE STOCKS PRINT OUT FORMAT. THERE"
: VTAB 12
: PRINT "ARE THREE CHOICES FROM WHICH TO SELECT."
: VTAB 14
: PRINT "CHOICE 1 SHOWS NO PERCENTAGES, JUST THE"
-----
3424 VTAB 16
: PRINT "ACTUAL STOCKS. CHOICE 2 GIVES INDIV DUAL"
: VTAB 18
: PRINT "CLASS 'I' STOCK PERCENTAGES BASED ON THE"
: VTAB 20
: PRINT "TOTAL FOR THAT PERIOD, ALONG WITH THE"
: GOSUB 9300
: IF GS = "M" GOTO 3000
-----
3426 GOSUB 9000
: VTAB 4
: PRINT "THE STOCKS. CHOICE 3 WILL SHOW THE CUR-"
: VTAB 6
: PRINT "RENT STOCKS AS PERCENTAGES OF THE ORIG-"
: VTAB 8
: PRINT "INAL TIME PERIOD STOCKS. THE PERCENT OP-"
-----
3428 VTAB 10
: PRINT "TION MAY BE CHANGED AT ANY TIME THROUGH"
: VTAB 12
: PRINT "THE CHANGE OR MODIFY MAIN MENU."
: GOSUB 9200
: GOTO 3000
-----
3480 GOSUB 9000
```

```
: VTAB 3
: HTAB 15
: PRINT "EXT RANGE +T"
: VTAB 6
: HTAB 4
: PRINT "EXT RANGE +T ALLOWS THE MAN-MOD USER"
: VTAB 8
: PRINT "TO INCREASE TIME (T). EXTEND RANGE +T IS"
: VTAB 10
: PRINT "THE END PERIOD FOR CALCULATIONS. THE EX-"
-----
3482 VTAB 12
: PRINT "TENDED RANGE WILL NOT BE ADDED TO TIME,"
: VTAB 14
: PRINT "IT WILL REPLACE THE TIME (T). IT IS USED"
: VTAB 16
: PRINT "IN CONJUNCTION WITH THE CONTINUE RANGE"
-----
3484 VTAB 18
: PRINT "OPTION OF THE MAIN PROGRAM'S CALCULATION"
: VTAB 20
: PRINT "ROUTINE."
: GOSUB 9200
: GOTO 3000
-----
3540 GOSUB 9000
: VTAB 3
: HTAB 16
: PRINT "(P) ELEMENT"
: VTAB 6
: HTAB 3
: PRINT "THE (P) ELEMENT VARIABLE CHOICE ALLOWS"
: VTAB 8
: PRINT "THE MAN-MOD USER TO CHANGE OR CORRECT"
: VTAB 10
: PRINT "PARTICULAR ELEMENTS OF THE MATRIX (P)."
-----
3542 VTAB 12
: PRINT "THE USER CAN CHANGE AN ELEMENT THROUGH"
: VTAB 14
: PRINT "THE 'CHANGE OR MODIFY' MENU OPTION. THE"
: VTAB 16
: PRINT "OPTION CAN BE USED TO MANIPULATE STOCKS"
-----
3544 VTAB 18
: PRINT "AND TRANSITIONAL FLOWS."
: GOSUB 9200
: GOTO 3000
-----
3600 GOSUB 9000
```

```

: VTAB 3
: HTAB 17
: PRINT "(P) ROW"
: VTAB 6
: HTAB 3
: PRINT "THE (P) ROW OPTION IS SIMILAR TO THE"
: VTAB 8
: PRINT "(P) ELEMENT OPTION. THE ONLY DIFFERENCE"
-----
3602 VTAB 10
: PRINT "IS THAT THIS SELECTION WILL CHANGE OR"
: VTAB 12
: PRINT "MODIFY A WHOLE ROW OF THE MATRIX (P)."
: GOSUB 9200
: GOTO 3000
-----
3660 GOSUB 9000
: VTAB 3
: HTAB 16
: PRINT "RESET STKS"
: VTAB 6
: HTAB 3
: PRINT "THE RESET STKS OPTION ALLOWS THE USER"
-----
3662 VTAB 8
: PRINT "TO RESET THE CALCULATED STOCKS TO THE"
: VTAB 10
: PRINT "INITIAL INPUT. BY SELECTING CALCULATION"
: VTAB 12
: PRINT "OPTIONS 1 OR 2, THE STOCKS WILL BE RESET"
-----
3664 VTAB 14
: PRINT "AUTOMATICALLY TO ORIGINAL DATA INPUTS."
: VTAB 16
: PRINT "MAN-MOD RESET OPTION IS LOCATED IN THE"
: VTAB 18
: PRINT "'CHANGE OR MODIFY' MAIN MENU."
: GOSUB 9200
: GOTO 3000
-----
4000 GOSUB 9000
-----
4002 VTAB 4
: HTAB 13
: PRINT "OPTIONS' REVIEW"
-----
4004 VTAB 7
: HTAB 3
: PRINT "(1) FIXED RECRUITMENT VECTOR"
: VTAB 9

```

```

: HTAB 3
: PRINT "(2) ADDITIVE (RECRUIT SIZE)"
: VTAB 11
: HTAB 3
: PRINT "(3) MULTIPLICATIVE (RECRUIT SIZE)"
-----
4006 VTAB 13
: HTAB 3
: PRINT "(4) ADDITIVE (SYSTEM SIZE)"
: VTAB 15
: HTAB 3
: PRINT "(5) MULTIPLICATIVE (SYSTEM SIZE)"
: VTAB 17
: HTAB 3
: PRINT "(6) RETURN TO MENU"
-----
4008 GOSUB 9100
-----
4010 IF G < 1 OR G > 6 GOTO 4008
-----
4012 ON G GOTO 4100,4200,4300,4400,4500,1004
-----
4100 VTAB 3
: CALL - 958
: HTAB 9
: PRINT "FIXED RECRUITMENT VECTOR"
: VTAB 6
: HTAB 3
: PRINT "THE FIXED RECRUITMENT VECTOR PERMITS"
: VTAB 8
: PRINT "THE USER TO ENTER IN CLASS 'I' A CON-"
: VTAB 10
: PRINT "STANT RECRUITMENT NUMBER 'R', E.G.,"
-----
4102 VTAB 12
: PRINT "(52,15,3), EACH PERIOD. THE OPTION OUT-"
: VTAB 14
: PRINT "PUT YIELDS PREDICTED STOCK VECTORS FOR"
: VTAB 16
: PRINT "FUTURE PERIODS BASED ON THIS FIXED RE-"
: VTAB 18
: PRINT "CRUITMENT."
: GOSUB 9200
: GOTO 4000
-----
4200 VTAB 3
: CALL - 958
: HTAB 10
: PRINT "ADDITIVE (RECRUIT SIZE)"
: VTAB 6

```

```

: HTAB 3
: PRINT "THE ADDITIVE RECRUIT SIZE OPTION PER-"
: VTAB 8
: PRINT "MITS ONE TO INCREASE THE RECRUITMENT IN"
-----
4202  VTAB 10
: PRINT "CLASS 'I' EACH PERIOD BY A CONSTANT NUM-"
: VTAB 12
: PRINT "BER. EXAMPLE: TO INCREASE CLASS '1' RE-"
: VTAB 14
: PRINT "CRUITMENT BY 7, STARTING WITH A RECRUIT-"
: VTAB 16
: PRINT "MENT OF 70; RECRUITMENT FOR PERIOD 1"
-----
4204  VTAB 18
: PRINT "WOULD BE 77, FOR PERIOD 2 WOULD BE 84,"
: VTAB 20
: PRINT "AND SO ON. THE PROGRAM WILL ASK THE USER"
: GOSUB 9300
: IF G$ = "M" GOTO 4000
-----
4206  VTAB 3
: HTAB 1
: CALL - 958
: VTAB 4
: PRINT "FOR A TOTAL RECRUITMENT 'R', E.G. 100, A"
: VTAB 6
: PRINT "PERIOD ADDITIVE NUMBER, E.G. 10, AND A"
-----
4208  VTAB 8
: PRINT "PROPORTIONAL RECRUITMENT DISTRIBUTION"
: VTAB 10
: PRINT "VECTOR, I.E. (.70,.20,.10). THE PROPOR-"
: VTAB 12
: PRINT "TIONAL VECTOR WILL DISTRIBUTE THE TOTAL"
-----
4210  VTAB 14
: PRINT "'R' IN THE CLASSES. EXAMPLE, PERIOD 0,"
: VTAB 16
: PRINT "IF TOTAL 'R' IS 100, DISTRIBUTION WILL"
: VTAB 18
: PRINT "BE 70, 20, 10. BY ADDING 10 TO TOTAL"
-----
4212  VTAB 20
: PRINT "'R' EACH PERIOD, RECRUITMENT FOR PERIOD"
: GOSUB 9300
: IF G$ = "M" GOTO 4000
-----
4214  VTAB 3
: HTAB 1

```

```
: CALL - 958
: VTAB 4
: PRINT "1 WILL BE 77, 22, 11, AND SO ON. SYSTEM"
-----
4216 VTAB 6
: PRINT "RECRUITMENT CAN BE HELD CONSTANT BY USE-"
: VTAB 8
: PRINT "ING ZERO AS THE ADDITIVE NUMBER."
: GOSUB 9200
: GOTO 4000
-----
4300 VTAB 3
: CALL - 958
: HTAB 7
: PRINT "MULTIPLICATIVE (RECRUIT SIZE)"
: VTAB 6
: HTAB 3
: PRINT "MULTIPLICATIVE RECRUIT SIZE IS SIMILAR"
: VTAB 8
: PRINT "TO ADDITIVE RECRUIT SIZE. THE DIFFER-"
-----
4302 VTAB 10
: PRINT "ENCE IS IN HOW THE RECRUITMENT IS IN-"
: VTAB 12
: PRINT "CREASED EACH PERIOD. THE TOTAL NUMBER"
: VTAB 14
: PRINT "OF RECRUITS IS FIXED AND AN HISTORIAL"
-----
4304 VTAB 16
: PRINT "PROPORTION VECTOR IS USED. RECRUITMENT"
: VTAB 18
: PRINT "IS THEN INCREASED EACH PERIOD BY A MUL-"
: VTAB 20
: PRINT "TIPLICATIVE FACTOR, E.G., 1.2. THE TOTAL"
: GOSUB 9300
: IF G$ = "M" GOTO 4000
-----
4306 VTAB 3
: HTAB 1
: CALL - 958
: VTAB 4
: PRINT "RECRUITMENT 'R', E.G. 100, MULTIPLIED BY"
: VTAB 6
: PRINT "1.2 WILL GIVE A RECRUITMENT OF 120 FOR"
-----
4308 VTAB 8
: PRINT "PERIOD 1. A REVIEW OF THE ADDITIVE RE-"
: VTAB 10
: PRINT "CRUIT SIZE IS RECOMMENDED. THE RECRUIT-"
: VTAB 12
```

```

: PRINT "MENT SIZE CAN BE HELD CONSTANT BY USING"
-----
4310 VTAB 14
: PRINT "1.0 AS THE MULTIPLICATIVE FACTOR."
: GOSUB 9200
: GOTO 4000
-----
4400 VTAB 3
: CALL - 958
: HTAB 10
: PRINT "ADDITIVE (SYSTEM SIZE)"
: VTAB 6
: HTAB 4
: PRINT "THE ADDITIVE SYSTEM SIZE OPTION PER-"
: VTAB 8
: PRINT "MITS THE USER TO CALCULATE THE TOTAL RE-"
: VTAB 10
: PRINT "CRUITMENT 'R' REQUIRED TO MAINTAIN SYS-"
-----
4402 VTAB 12
: PRINT "TEM SIZE. THE USER MAY ELECT TO INCREASE"
: VTAB 14
: PRINT "OR DECREASE THE SYSTEM BY A FIXED ADDI-"
: VTAB 16
: PRINT "TIVE NUMBER EACH PERIOD, I.E. 10 OR -10."
: VTAB 18
: PRINT "THE OPTION REQUIRES A HISTORICAL PROPOR-"
-----
4404 VTAB 20
: PRINT "TION VECTOR TO DISTRIBUTE RECRUITMENT."
: GOSUB 9300
: IF G$ = "M" GOTO 4000
-----
4406 VTAB 3
: HTAB 1
: CALL - 958
: VTAB 4
: PRINT "AN EXAMPLE VECTOR IS: (.70, .20, .10)."
: VTAB 6
: PRINT "THE SYSTEM MAY BE HELD CONSTANT BY EN-"
: VTAB 8
: PRINT "TERING ZERO FOR THE ADDITIVE NUMBER."
: GOSUB 9200 GOTO 4000
-----
4500 VTAB 3
: CALL - 958
: HTAB 8
: PRINT "MULTIPLICATIVE (SYSTEM SIZE)"
: VTAB 6
: HTAB 3

```

```

: PRINT "THE MULTIPLICATIVE SYSTEM OPTION SIZE"
: VTAB 8
: PRINT "IS SIMILAR TO ADDITIVE SYSTEM SIZE. THE"
: VTAB 10
: PRINT "DIFFERENCE IS IN HOW THE SYSTEM IS IN-"
-----
4502  VTAB 12
: PRINT "CREASED OR DECREASED. THE OPTION USES A"
: VTAB 14
: PRINT "MULTIPLICATIVE FACTOR INSTEAD OF AN ADD-"
-----
4504  VTAB 16
: PRINT "ITIVE NUMBER, I.E. 1.2 OR .9. TO HOLD"
: VTAB 18
: PRINT "THE SYSTEM CONSTANT THE USER MAY USE 1.0"
: VTAB 20
: PRINT "AS A FACTOR. RECRUITMENT IS DISTRIBUTED"
: GOSUB 9300
: IF G$ = "M" GOTO 4000
:
-----
4506  VTAB 3
: HTAB 1
: CALL - 958
: VTAB 4
: PRINT "BY AN HISTORICAL PROPORTION VECTOR, I.E."
-----
4508  VTAB 6
: PRINT "(.70, .20, .10)."
: GOSUB 9200
: GOTO 4000
-----
5000  GOSUB 9000
: VTAB 6
: HTAB 6
: PRINT "REFERENCES & ACKNOWLEDGMENTS"
-----
5002  VTAB 11
: HTAB 10
: PRINT "(1) REFERENCES"
: VTAB 13
: HTAB 10
: PRINT "(2) ACKNOWLEDGMENTS"
: VTAB 15
: HTAB 10
: PRINT "(3) RETURN TO MENU"
-----
5004  GOSUB 9100
: IF G < 1 OR G > 3 GOTO 5004
-----
```

```
5006 ON G GOTO 5100,5200,1004
-----
5100 GOSUB 9000
: VTAB 4
: HTAB 13
: PRINT "MAJOR REFERENCES"
: VTAB 8
: PRINT "APPLE COMPUTER INC., BASIC PROGRAMMING"
: VTAB 10
: PRINT "REFERENCE MANUAL, 1978"
:
-----
5102 VTAB 14
: PRINT "BARTHOLOMEW, D. J., AND FORBES, A. F.,"
: VTAB 16
: PRINT "STATISTICAL TECHNQUES FOR MANPOWER, 2ND"
: VTAB 18
: PRINT "ED., WILEY 1979."
: GOSUB 9200
: GOTO 5000
-----
5200 GOSUB 9000
: VTAB 3
: HTAB 14
: PRINT "ACKNOWLEDGMENT"
: VTAB 6
: HTAB 3
: PRINT "MAN-MOD/FORMATTER IS A PRINT USING"
: VTAB 8
: PRINT "ROUTINE ALLOWING REAL OR INTEGER NUMBERS"
: VTAB 10
: PRINT "TO BE FORMATTED. IT IS A MODIFIED VER-"
-----
5202 VTAB 12
: PRINT "SION OF 'PRINT II', A COMPUTER SYSTEMS"
: VTAB 14
: PRINT "DESIGN COPYRIGHTED PROGRAM. PERMISSION"
: VTAB 16
: PRINT "HAS BEEN OBTAINED TO UTILIZE THE MODI-"
-----
5204 VTAB 18
: PRINT "FIED ROUTINE FOR MAN-MOD; ANY OTHER AP-"
: VTAB 20
: PRINT "PLICATION OF THE ROUTINE IS PROHIBITED."
: GOSUB 9300
: IF G$ = "M" GOTO 5000
-----
5206 GOSUB 9000
: VTAB 3
: HTAB 14
```

```
: PRINT "ACKNOWLEDGMENT"
: VTAB 6
: HTAB 3
: PRINT "THE AUTHOR WOULD LIKE TO THANK PROFES-"
: VTAB 8
: PRINT "SORS RICHARD ELSTER AND JAMES ESARY FOR"
-----
5208 VTAB 10
: PRINT "THEIR ASSISTANCE AND SUPPORT WITH THE"
: VTAB 12
: PRINT "MAN-MOD ADAPTATION. A SPECIAL THANKS TO"
: VTAB 14
: PRINT "THE AUTHOR'S WIFE, SANDRA, WHOSE UNDER-"
-----
5210 VTAB 16
: PRINT "STANDING WAS STRETCHED TO THE LIMITS,"
: VTAB 18
: PRINT "BUT WITHOUT WHOSE HELP THIS THESIS WOULD"
: VTAB 20
: PRINT "NOT HAVE BEEN COMPLETED."
: GOSUB 9200
: GOTO 5000
-----
6000 HOME
: VTAB 11
: HTAB 8
: PRINT "<RETURNING TO MAIN MENU>"
-----
6002 PRINT D$;"BLOAD MAN-MOD/LINKER, A520"
-----
6004 CALL 520"MAN-MOD/PROGRAM"
-----
9000 TEXT
: HOME
: VTAB 1
: HTAB 1
: INVERSE
: PRINT " * MAN-MOD TRANSITION MATRIX PROGRAM * "
: NORMAL
: RETURN
-----
9100 VTAB 23
: HTAB 1
: FOR I = 1 TO 39
: PRINT "'";
: NEXT
: VTAB 24
: HTAB 12
: PRINT "PRESS SELECTION ";
: GET G$
```

: G = VAL (G\$)
: RETURN

9200 VTAB 23
: FOR I = 1 TO 39
: PRINT " ";
: NEXT
: VTAB 24
: HTAB 10
: PRINT "PRESS RETURN FOR MENU ";
: GET G\$
: RETURN

9300 VTAB 23
: HTAB 1
: FOR I = 1 TO 39
: PRINT " ";
: NEXT
: VTAB 24
: HTAB 2
: PRINT "PRESS (C) TO CONTINUE, (M) FOR MENU ";
: GET G\$
: RETURN

APPENDIX C

MAN-MOD/PROGRAM MODULE

PROGRAM LISTING

The MAN-MOD/PROGRAM module is written in Apple II Applesoft basic. The program was listed using XLISTER, a Beagle Brothers Inc. prgram.

MAN-MOD/PROGRAM (PROGRAM LISTING)

```
-----  
1000 REM      MAN-MOD/PROGRAM PROGRAM: "FOR" IS IN QUOTES  
      IN LINES 1004,10518,10520,10524,10526,10528,1072  
      2,10724,10728,10730,10732 FOR PRINT LISTING ONLY  
-----  
1002 D$ = CHR$ (4)  
      : REM CTRL-D  
-----  
1004 PRINT "FOR"6,0;  
      : Q$ = CHR$ (34)  
-----  
1006 GOSUB 20100  
-----  
1008 VTAB 5  
      : HTAB 13  
      : PRINT "<MAN-MOD MENU>"  
-----  
1010 HTAB 13  
      : PRINT "-----"  
-----  
1012 VTAB 10  
      : HTAB 4  
      : PRINT "(1) MAN-MOD THEORY & DEFINITIONS"  
-----  
1014 VTAB 12  
      : HTAB 4  
      : PRINT "(2) MAN-MOD OPERATIONAL MODEL"  
-----  
1016 VTAB 14  
      : HTAB 4  
      : PRINT "(3) SAVE DATA FILE TO DISK"  
-----  
1018 VTAB 16  
      : HTAB 4  
      : PRINT "(4) EXIT MAN-MOD PROGRAM"  
-----  
1020 GOSUB 20200  
-----  
1022 IF G < 1 OR G > 4 GOTO 1020  
-----  
1024 ON G GOTO 2000,3000,9000,9200  
-----  
2000 HOME  
      : VTAB 11  
      : HTAB 8  
      : PRINT "<THEORY AND DEFINITIONS>"  
-----  
2002 PRINT D$;"BLOAD MAN-MOD/LINKER,A520"
```

```
-----  
2004 CALL 520"MAN-MOD/THEORY"  
-----  
3000 GOSUB 20100  
-----  
3002 VTAB 6  
: HTAB 7  
: PRINT "(1) INPUT NEW DATA"  
: PRINT  
-----  
3004 HTAB 7  
: PRINT "(2) RECALL DATA FROM DISK"  
: PRINT  
-----  
3006 HTAB 7  
: PRINT "(3) CHANGE OR MODIFY PARAMETERS"  
: PRINT  
-----  
3008 HTAB 7  
: PRINT "(4) LIST INPUTS OR PARAMETERS"  
: PRINT  
-----  
3010 HTAB 7  
: PRINT "(5) CALCULATE WITH CURRENT DATA"  
: PRINT  
-----  
3012 HTAB 7  
: PRINT "(6) RETURN TO MENU"  
-----  
3014 GOSUB 20200  
-----  
3016 IF G < 1 OR G > 6 GOTO 3014  
-----  
3018 ON G GOTO 4000,5000,6000,8000,10000,1006  
-----  
4000 GOSUB 20100  
-----  
4002 VTAB 4  
: HTAB 13  
: PRINT "<NEW DATA INPUT>"  
: HTAB 13  
: PRINT "-----"  
-----  
4004 VTAB 9  
: CALL - 958  
: HTAB 2  
: PRINT "INPUT NEW DATA FILE NAME (MAX 15 CHRS)"  
: PRINT  
: HTAB 14  
: PRINT "PRESS RETURN"
```

```
-----  
4006  VTAB 18  
: HTAB 19  
: PRINT "-----"  
-----  
4008  VTAB 17  
: HTAB 6  
: INPUT "FILE NAME IS ";NF$  
-----  
4010  VTAB 4  
: CALL - 958  
: VTAB 9  
: HTAB 10  
: PRINT "NEW DATA FILE NAME IS:"  
-----  
4012  VTAB 13  
: HTAB (19 - INT ( LEN (NF$) / 2 ))  
: PRINT Q$;NF$;Q$  
-----  
4014  GOSUB 20300  
-----  
4016  IF G$ = "A" GOTO 4100  
-----  
4018  IF G$ = "R" GOTO 4004  
-----  
4020  IF G$ = "E" GOTO 3000  
-----  
4022  GOTO 4014  
-----  
4100  ONERR GOTO 4104  
-----  
4102  GOSUB 20100  
-----  
4104  VTAB 9  
: CALL - 958  
: HTAB 3  
: PRINT "INPUT NUMBER (K) OF CLASSES (MAX 9)"  
: PRINT  
: HTAB 14  
: PRINT "PRESS RETURN"  
-----  
4106  VTAB 16  
: HTAB 13  
: INPUT "INPUT NUMBER ";K  
-----  
4108  IF K < 1 OR K > 9 GOTO 4104  
-----  
4110  VTAB 9  
: CALL - 958  
: HTAB 4
```

```

: PRINT "NUMBER (K) OF CLASSES ENTERED IS:"
: VTAB 12
: HTAB 19
: PRINT "(""K"")"
-----
4112 GOSUB 20300
-----
4114 IF G$ = "A" GOTO 4200
-----
4116 IF G$ = "R" GOTO 4100
-----
4118 IF G$ = "E" GOTO 3000
-----
4120 GOTO 4112
-----
4200 ONERR GOTO 4204
-----
4202 GOSUB 20100
-----
4204 VTAB 4
: CALL - 958
: HTAB 3
: PRINT "CLASS SIZES VECTOR (N) -> (1 BY "K")"
-----
4206 VTAB 7
: HTAB 2
: PRINT "INPUT ROW (R1) AND COLUMN (C1 TO C"K")"
: VTAB 10
: HTAB 12
: PRINT "R1, ";
: II = 9
: FOR I = 1 TO K
-----
4208 HTAB 16
: PRINT "C" I": ";
: INPUT N(I)
-----
4210 IF N(I) < 0 GOTO 4214
-----
4212 NEXT
: DO = .0000001
: FOR I = 1 TO K
: M(I) = N(I)
: DO = DO + N(I)
: NEXT
: GOTO 4216
-----
4214 VTAB (II + I)
: HTAB 21
: FLASH

```

```

: PRINT "INVALID NUMBER"
: NORMAL
: II = II + 1
: GOTO 4208
-----
4216 GOSUB 20100
-----
4218 VTAB 5
: CALL - 958
: HTAB 3
: PRINT "CLASS SIZES VECTOR (N) ENTERED IS:"
-----
4220 VTAB 8
: HTAB 13
: PRINT "R1, ";
: FOR I = 1 TO K
:   HTAB 17
:   PRINT "C" I": "#M(I)
: NEXT
-----
4222 GOSUB 20300
-----
4224 IF G$ = "A" GOTO 4300
-----
4226 IF G$ = "R" GOTO 4200
-----
4228 IF G$ = "E" GOTO 3000
-----
4230 GOTO 4222
-----
4300 ONERR GOTO 4308
-----
4302 GOSUB 20100
: I = 1
-----
4304 VTAB 4
: CALL - 958
: HTAB 3
: PRINT "INITIAL FRACTIONAL FLOW MATRIX (P)"
: HTAB 16
: PRINT "(" K" BY "K")"
: PRINT
-----
4306 HTAB 3
: PRINT "INPUT ROW (R(I)) AND COLUMN (C(J))"
: HTAB 9
: PRINT "FOR THE P(I,J) ELEMENT"
: II = 9
-----
4308 VTAB 10

```

```

: HTAB 1
: CALL - 958
: HTAB 13
: PRINT "R" I", "
: FOR J = 1 TO K
-----
4310   HTAB 17
: PRINT "C" J": ";
: INPUT P(I,J)
-----
4312   IF P(I,J) < 0 OR P(I,J) > 1 GOTO 4318
-----
4314   NEXT J
: ST = 0
: FOR IP = 1 TO K
:   ST = ST + P(I,IP)
: NEXT
: IF ST > 1 GOTO 4320
-----
4316   GOTO 4324
-----
4318   VTAB (II + J)
: HTAB 21
: FLASH
: PRINT "INVALID NUMBER"
: NORMAL
: II = II + 1
: GOTO 4310
-----
4320   GOSUB 20500
: IF G$ = "E" GOTO 3000
-----
4322   GOTO 4304
-----
4324   VTAB 4
: CALL - 958
: VTAB 7
: HTAB 13
: PRINT "ROW " I" INPUT IS:"
-----
4326   VTAB 10
: HTAB 13
: PRINT "R" I", "
: FOR L = 1 TO K
:   HTAB 17
:   PRINT "C" L": ";
:   P1 = P(I,L)
:   GOSUB 20000
: NEXT
-----

```

```
4328 GOSUB 20300
-----
4330 IF G$ = "A" GOTO 4338
-----
4332 IF G$ = "R" GOTO 4304
-----
4334 IF G$ = "E" GOTO 3000
-----
4336 GOTO 4328
-----
4338 I = I + 1
: IF I > K GOTO 4400
-----
4340 GOTO 4304
-----
4400 ONERR GOTO 4404
-----
4402 GOSUB 20100
-----
4404 VTAB 5
: CALL - 958
: HTAB 5
: PRINT "RECRUITMENT OPTIONS INPUT MENU"
-----
4406 VTAB 9
: HTAB 3
: PRINT "(1) FIXED RECRUITMENT VECTOR"
: PRINT
: HTAB 3
: PRINT "(2) ADDITIVE (RECRUIT SIZE)"
: PRINT
: HTAB 3
: PRINT "(3) MULTIPLICATIVE (RECRUIT SIZE)"
: PRINT
-----
4408 HTAB 3
: PRINT "(4) ADDITIVE (SYSTEM SIZE)"
: PRINT
: HTAB 3
: PRINT "(5) MULTIPLICATIVE (SYSTEM SIZE)"
-----
4410 GOSUB 20200
: OP = G
-----
4412 IF OP < 1 OR OP > 5 GOTO 4410
-----
4414 IF OP = > 2 GOTO 4448
-----
4416 ONERR GOTO 4422
-----
```

```
4418  A = 1
      : B$ = "0"
      : C = 0
-----
4420  GOSUB 20100
-----
4422  VTAB 5
      : CALL - 958
      : HTAB 2
      : PRINT "RECRUITMENT VECTOR (R) FOR OPTION (1)"
      : HTAB 4
      : PRINT "INPUT ACTUAL RECRUITMENT NUMBERS"
      : HTAB 12
      : PRINT "(I.E., 52, 15, 3)"
-----
4424  VTAB 10
      : HTAB 2
      : PRINT "INPUT ROW (R1) AND COLUMN (C1 TO C"K")"
      : VTAB 12
      : HTAB 12
      : PRINT "R1, ";
      : II = 11
      : FOR I = 1 TO K
-----
4426  HTAB 16
      : PRINT "C"I": ";
      : INPUT R(I)
-----
4428  IF R(I) < 0 GOTO 4432
-----
4430  NEXT
      : GOTO 4434
-----
4432  VTAB (II + I)
      : HTAB 21
      : FLASH
      : PRINT "INVALID NUMBER"
      : NORMAL
      : II = II + 1
      : GOTO 4426
-----
4434  VTAB 5
      : CALL - 958
      : HTAB 3
      : PRINT "RECRUITMENT VECTOR (R) ENTERED IS:"
-----
4436  VTAB 9
      : HTAB 13
      : PRINT "R1, ";
      : FOR I = 1 TO K
```

```

: HTAB 17
: PRINT "C" I": ";#R(I)
: NEXT
-----
4438 GOSUB 20300
-----
4440 IF G$ = "A" GOTO 4600
-----
4442 IF G$ = "R" GOTO 4416
-----
4444 IF G$ = "E" GOTO 3000
-----
4446 GOTO 4438
-----
4448 IF OP = 2 OR OP = 4 THEN B$ = "+"
-----
4450 IF OP = 3 OR OP = 5 THEN B$ = "*"
-----
4452 IF OP = 4 OR OP = 5 THEN A = - 1
-----
4454 ONERR GOTO 4460
-----
4456 IF A = - 1 THEN GOSUB 20900
-----
4458 GOSUB 20100
-----
4460 VTAB 5
: CALL - 958
: PRINT "RECRUITMENT VECTOR (R) FOR OPTIONS (2-5)"
: VTAB 6
: HTAB 7
: PRINT "INPUT HISTORICAL PROPORTIONS"
: HTAB 10
: PRINT "(I.E., .74, .21, .05)"
-----
4462 VTAB 10
: HTAB 2
: PRINT "INPUT ROW (R1) AND COLUMN (C1 TO C"K")"
: VTAB 12
: HTAB 12
: PRINT "R1, ";
: II = 11
: FOR I = 1 TO K
-----
4464 HTAB 16
: PRINT "C" I": ";
: INPUT R(I)
-----
4466 IF R(I) < 0 OR R(I) > 1 GOTO 4472
-----

```

```
4468  NEXT
      : RR = 0
      : FOR I = 1 TO K
      :   RR = RR + R(I)
      : NEXT
      : IF RR < 1 OR RR > 1 GOTO 4474
-----
4470  GOTO 4476
-----
4472  VTAB (II + I)
      : HTAB 21
      : FLASH
      : PRINT "INVALID NUMBER"
      : NORMAL
      : II = II + 1
      : GOTO 4464
-----
4474  GOSUB 20100
      : VTAB 11
      : HTAB 3
      : FLASH
      : PRINT "RECRUITMENT VECTOR MUST EQUAL ONE"
      : NORMAL
      : PRINT
      : HTAB 5
      : PRINT "PRESS RETURN TO REENTER VECTOR"
      : VTAB 24
      : HTAB 13
      : PRINT "PRESS RETURN ";
      : GET G$
      : GOTO 4454
-----
4476  VTAB 5
      : CALL - 958
      : HTAB 3
      : PRINT "RECRUITMENT VECTOR (R) ENTERED IS:"
-----
4478  VTAB 9
      : HTAB 13
      : PRINT "R1, ";
      : FOR I = 1 TO K
      :   HTAB 17
      :   PRINT "C" I": ";
      :   P1 = R(I)
      :   GOSUB 20000
      : NEXT
-----
4480  GOSUB 20300
-----
4482  IF G$ = "A" GOTO 4490
```

```
-----  
4484 IF G$ = "R" GOTO 4454  
-----  
4486 IF G$ = "E" GOTO 3000  
-----  
4488 GOTO 4480  
-----  
4490 IF OP = 4 OR OP = 5 THEN 4514  
-----  
4492 ONERR GOTO 4496  
-----  
4494 GOSUB 20100  
-----  
4496 VTAB 5  
: CALL - 958  
: HTAB 3  
: PRINT "NUMBER (A) RECRUITS ENTERING SYSTEM"  
-----  
4498 VTAB 7  
: CALL - 958  
: HTAB 13  
: INPUT "INPUT (A) ";A  
-----  
4500 IF A < 0 GOTO 4498  
-----  
4502 VTAB 5  
: CALL - 958  
: HTAB 4  
: PRINT "TOTAL NUMBER (A) ENTERING SYSTEM"  
: PRINT  
: HTAB 19  
: PRINT "IS"  
: VTAB 12  
: A$ = STR$ (A)  
: HTAB (20 - INT (( LEN (A$) + 2 ) / 2))  
: PRINT "("A")"  
-----  
4504 GOSUB 20300  
-----  
4506 IF G$ = "A" GOTO 4514  
-----  
4508 IF G$ = "R" GOTO 4494  
-----  
4510 IF G$ = "E" GOTO 3000  
-----  
4512 GOTO 4504  
-----  
4514 IF OP = 3 OR OP = 5 GOTO 4536  
-----  
4516 ONERR GOTO 4520
```

```
-----  
4518 GOSUB 20100  
-----  
4520  VTAB 5  
: HTAB 1  
: CALL - 958  
: HTAB 7  
: PRINT "NUMBER TO ADDITIVELY CHANGE"  
: PRINT  
: HTAB 9  
: PRINT "RECRUITS OR SYSTEM SIZE"  
-----  
4522  VTAB 11  
: HTAB 13  
: INPUT "INPUT (C): ";C  
-----  
4524  VTAB 5  
: CALL - 958  
: HTAB 6  
: PRINT "TOTAL NUMBER (C) TO INCREASE"  
: PRINT  
: HTAB 10  
: PRINT "RECRUITS OR SYSTEM IS"  
: VTAB 12  
: C$ = STR$ (C)  
: HTAB (20 - INT (( LEN (C$) + 2 ) / 2))  
: PRINT "("C")"  
-----  
4526 GOSUB 20300  
-----  
4528  IF G$ = "A" GOTO 4600  
-----  
4530  IF G$ = "R" GOTO 4520  
-----  
4532  IF G$ = "E" GOTO 3000  
-----  
4534  GOTO 4526  
-----  
4536  ONERR GOTO 4540  
-----  
4538 GOSUB 20100  
-----  
4540  VTAB 5  
: CALL - 958  
: HTAB 4  
: PRINT "MULTIPLICATIVE FACTOR TO INCREASE"  
: PRINT  
: HTAB 9  
: PRINT "RECRUITS OR SYSTEM SIZE"  
-----
```

```
4542  VTAB 11
      : HTAB 13
      : INPUT "INPUT (C): ";C
-----
4544  VTAB 5
      : CALL - 958
      : HTAB 2
      : PRINT "MULTIPLICATIVE FACTOR (C) TO INCREASE"
      : PRINT
      : HTAB 10
      : PRINT "RECRUITS OR SYSTEM IS"
      : VTAB 12
      : C$ = STR$ (C)
      : HTAB (20 - INT ((LEN (C$) + 2) / 2))
      : PRINT "("C")"
-----
4546  GOSUB 20300
-----
4548  IF G$ = "A" GOTO 4600
-----
4550  IF G$ = "R" GOTO 4540
-----
4552  IF G$ = "E" GOTO 3000
-----
4554  GOTO 4546
-----
4600  ONERR GOTO 4604
-----
4602  GOSUB 20100
-----
4604  VTAB 4
      : CALL - 958
      : VTAB 6
      : HTAB 4
      : PRINT "INPUT NUMBER (T) OF TIME PERIODS"
      : PRINT
      : HTAB 14
      : PRINT "PRESS RETURN"
-----
4606  VTAB 15
      : HTAB 13
      : INPUT "INPUT NUMBER ";T
-----
4608  IF T < 1 GOTO 4604
-----
4610  VTAB 5
      : CALL - 958
      : VTAB 9
      : HTAB 2
      : PRINT "NUMBER (T) OF TIME PERIODS ENTERED IS:"
```

```
: PRINT
: PRINT
: HTAB 19
: PRINT "("T")"
-----
4612 GOSUB 20300
-----
4614 IF G$ = "A" GOTO 4700
-----
4616 IF G$ = "R" GOTO 4600
-----
4618 IF G$ = "E" GOTO 3000
-----
4620 GOTO 4612
-----
4700 ONERR GOTO 4704
-----
4702 GOSUB 20100
-----
4704 VTAB 4
: CALL - 958
: VTAB 6
: HTAB 8
: PRINT "SELECT PERCENTAGES OPTION"
: PRINT
: HTAB 14
: PRINT "FOR PRINTOUT"
-----
4706 VTAB 12
: HTAB 2
: PRINT "(1) NO CLASS PERCENTAGES (%)"
: PRINT
: HTAB 2
: PRINT "(2) GRADE SIZE AS % OF TOTAL SIZE"
: PRINT
: HTAB 2
: PRINT "(3) GRADE SIZE AS % OF ORIGINAL SIZE"
-----
4708 GOSUB 20200
: Z$ = G$
-----
4710 IF Z$ = "1" OR Z$ = "2" OR Z$ = "3" GOTO 4714
-----
4712 GOTO 4708
-----
4714 HOME
: VTAB 11
: HTAB 8
: PRINT "INITIAL INPUTS COMPLETED"
: FOR I = 1 TO 1500
```

```
: NEXT
: GOTO 9000
-----
5000 GOSUB 20100
-----
5002 VTAB 4
: HTAB 12
: PRINT "<RECALL OLD DATA>"
: HTAB 12
: PRINT "-----"
-----
5004 VTAB 9
: CALL - 958
: HTAB 3
: PRINT "ENTER DATA FILE NAME TO BE RECALLED"
: PRINT
: HTAB 13
: PRINT "(PRESS RETURN)"
-----
5006 VTAB 18
: HTAB 19
: PRINT "-----"
-----
5008 VTAB 17
: HTAB 6
: INPUT "FILE NAME IS ";NFS
-----
5010 VTAB 4
: CALL - 958
: VTAB 9
: HTAB 7
: PRINT "RECALLED DATA FILE NAME IS"
-----
5012 VTAB 13
: HTAB (19 - INT ( LEN (NFS) / 2 ))
: PRINT Q$;NFS;Q$
-----
5014 GOSUB 20300
-----
5016 IF G$ = "A" GOTO 5024
-----
5018 IF G$ = "R" GOTO 5000
-----
5020 IF G$ = "E" GOTO 3000
-----
5022 GOTO 5014
-----
5024 GOSUB 20100
-----
5026 VTAB 8
```

```
: HTAB 9
: PRINT "INPUT DISK DRIVE NUMBER"
: PRINT
: PRINT
: HTAB 12
: PRINT "(1) DISK DRIVE 1"
: PRINT
: HTAB 12
: PRINT "(2) DISK DRIVE 2"
: PRINT
: HTAB 12
: PRINT "(3) ESCAPE TO MENU"
-----
5028 GOSUB 20200
-----
5030 IF G < 1 OR G > 3 GOTO 5028
-----
5032 DN = G
-----
5034 IF G = 3 THEN 3000
-----
5100 HOME
: VTAB 11
: HTAB 7
: PRINT "<DATA FILE IS BEING LOADED>"
-----
5102 ONERR GOTO 5200
-----
5104 PRINT
: PRINT D$;"OPEN"NF$" ,D";DN
-----
5106 PRINT D$;"READ";NFS
-----
5108 INPUT K
: FOR I = 1 TO 9
: INPUT NN(I)
: NEXT
: FOR I = 1 TO 9
: FOR J = 1 TO 9
: INPUT PP(I,J)
: NEXT
: NEXT
: FOR I = 1 TO 9
: INPUT RR(I)
: NEXT
: INPUT A
: INPUT B$
: INPUT C
: INPUT T
: INPUT Z$
```

```
: INPUT OP
: INPUT DO
: PRINT D$  
-----
5110 FOR I = 1 TO K
:   N(I) = NN(I)
:   M(I) = N(I)
: NEXT
: FOR I = 1 TO K
:   FOR J = 1 TO K
:     P(I,J) = PP(I,J)
:   NEXT
: NEXT
: FOR I = 1 TO K
:   R(I) = RR(I)
: NEXT  
-----
5112 PRINT D$;"CLOSE"  
-----
5114 GOSUB 20900
: GOTO 3000  
-----
5200 HOME
: VTAB 1
: HTAB 2
: FLASH
: PRINT "ERROR IN FILE NAME OR DISK SELECTION"
: NORMAL
: PRINT
: HTAB 15
: PRINT "<REVERIFY>"
: GOTO 5010  
-----
6000 GOSUB 20100  
-----
6002 VTAB 5
: HTAB 9
: PRINT "<CHANGE OR MODIFY DATA>"
: HTAB 9
: PRINT "-----"
: PRINT  
-----
6004 VTAB 9
: HTAB 3
: PRINT "(1) FILE NAME";
: HTAB 23
: PRINT "(7) PERCENT (%)"
: HTAB 3
: PRINT "(2) INITIAL STKS";
: HTAB 23
```

```

: PRINT "(8) EXT RANGE +T"
: HTAB 3
: PRINT "(3) MATRIX (P)";
: HTAB 23
: PRINT "(9) (P) ELEMENT"
-----
6006 HTAB 3
: PRINT "(4) RECRUITMENT";
: HTAB 23
: PRINT "(10) (P) ROW"
: HTAB 3
: PRINT "(5) OPTIONS";
: HTAB 23
: PRINT "(11) RESET STKS"
: HTAB 3
: PRINT "(6) TIME (T)";
: HTAB 23
: PRINT "(12) RETURN MENU"
: PRINT
-----
6008 VTAB 18
: HTAB 5
: PRINT "** GOTO THEORY FOR EXPLANATIONS **"
-----
6010 VTAB 23
: HTAB 1
: FOR I = 1 TO 39
: PRINT "";
: NEXT
: VTAB 24
: HTAB 11
: PRINT "INPUT SELECTION ";
: INPUT G$
: G = VAL (G$)
-----
6012 IF G < 1 OR G > 12 GOTO 6000
-----
6014 ON G GOTO 6100,6200,6300,6436,6400,6600,6700,6800,69
00,7000,7100,7200
-----
6016 GOTO 6000
-----
6100 GOSUB 20100
-----
6102 VTAB 5
: CALL - 958
: VTAB 09
: HTAB 12
: PRINT "DATA FILE NAME IS:"
-----
```

```
6104  VTAB 13
      : HTAB (19 - INT ( LEN (NFS) / 2))
      : PRINT Q$;NFS;Q$  
-----
6106  GOSUB 20400  
-----
6108  IF G$ = "A" GOTO 6000  
-----
6110  IF G$ = "R" GOTO 6114  
-----
6112  GOTO 6106  
-----
6114  VTAB 5
      : CALL - 958
      : HTAB 2
      : PRINT "INPUT NEW DATA FILE NAME (MAX 15 CHRS)"
      : PRINT
      : HTAB 14
      : PRINT "PRESS RETURN"  
-----
6116  VTAB 16
      : HTAB 19
      : PRINT "-----"  
-----
6118  VTAB 15
      : HTAB 6
      : INPUT "FILE NAME IS ";NFS  
-----
6120  GOTO 6100  
-----
6200  GOSUB 20100  
-----
6202  VTAB 5
      : CALL - 958
      : HTAB 3
      : PRINT "CLASS SIZES VECTOR (N) ENTERED IS:"  
-----
6204  VTAB 9
      : HTAB 13
      : PRINT "R1, ";
      : FOR I = 1 TO K
      :   HTAB 17
      :   PRINT "C" I ":"; #M(I)
      : NEXT  
-----
6206  GOSUB 20400  
-----
6208  IF G$ = "A" GOTO 6000  
-----
6210  IF G$ = "R" GOTO 6214
```

```
-----  
6212 GOTO 6206  
-----  
6214 ONERR GOTO 6216  
-----  
6216 VTAB 5  
: CALL - 958  
: HTAB 3  
: PRINT "CLASS SIZES VECTOR (N) -> (1 BY "K")"  
-----  
6218 VTAB 9  
: HTAB 3  
: PRINT "INPUT ROW (R1) AND COLUMN (1 TO "K")"  
: PRINT  
: HTAB 12  
: PRINT "R1, "  
: FOR I = 1 TO K  
: HTAB 16  
: PRINT "C" I": "  
: INPUT N(I)  
: NEXT  
: FOR I = 1 TO K  
: M(I) = N(I)  
: NEXT  
-----  
6220 GOTO 6200  
-----  
6300 GOSUB 20100  
: I = 1  
-----  
6302 VTAB 4  
: CALL - 958  
: VTAB 5  
: HTAB 13  
: PRINT "ROW "I" INPUT IS:"  
-----  
6304 VTAB 8  
: HTAB 13  
: PRINT "R" I", "  
: FOR L = 1 TO K  
: HTAB 17  
: PRINT "C" L": "  
: P1 = P(I,L)  
: GOSUB 20000  
: NEXT  
-----  
6306 GOSUB 20300  
-----  
6308 IF G$ = "A" GOTO 6316  
-----
```

```

6310  IF G$ = "E" GOTO 6000
-----
6312  IF G$ = "R" GOTO 6320
-----
6314  GOTO 6306
-----
6316  I = I + 1
: IF I > K GOTO 6000
-----
6318  GOTO 6302
-----
6320  ONERR GOTO 6326
-----
6322  VTAB 4
: CALL - 958
: HTAB 3
: PRINT "INITIAL FRACTIONAL FLOW MATRIX (P)"
: HTAB 16
: PRINT "("K" BY "K")"
: PRINT
-----
6324  HTAB 3
: PRINT "INPUT ROW (R(I)) AND COLUMN (C(J))"
: HTAB 9
: PRINT "FOR THE P(I,J) ELEMENT"
: II = 9
-----
6326  VTAB 10
: HTAB 1
: CALL - 958
: HTAB 13
: PRINT "R" I", "
: FOR J = 1 TO K
-----
6328  HTAB 17
: PRINT "C" J": ";
: INPUT P(I,J)
-----
6330  IF P(I,J) < 0 OR P(I,J) > 1 GOTO 6336
-----
6332  NEXT
: ST = 0
: FOR IP = 1 TO K
: ST = ST + P(I,IP)
: NEXT
: IF ST > 1 GOTO 6338
-----
6334  GOTO 6302
-----
6336  VTAB (II + J)

```

```

: HTAB 21
: FLASH
: PRINT "INVALID NUMBER"
: NORMAL
: II = II + 1
: GOTO 6328
-----
6338 GOSUB 20500
: IF G$ = "E" GOTO 6000
-----
6340 GOTO 6300
-----
6400 GOSUB 20100
-----
6402 VTAB 8
: CALL - 958
: HTAB 11
: PRINT "OPTION SELECTED IS:"
: VTAB 13
-----
6404 IF OP = 1 THEN PRINT TAB( 8 )"FIXED RECRUITMENT VECTO
R"
-----
6406 IF OP = 2 THEN PRINT TAB( 9 )"ADDITIVE (RECRUIT SIZE)
"
-----
6408 IF OP = 3 THEN PRINT TAB( 6 )"MULTIPLICATIVE (RECRUIT
SIZE)"
-----
6410 IF OP = 4 THEN PRINT TAB( 9 )"ADDITIVE (SYSTEM SIZE)"
-----
6412 IF OP = 5 THEN PRINT TAB( 6 )"MULTIPLICATIVE (SYSTEM
SIZE)"
-----
6414 VTAB 22
: HTAB 2
: PRINT "(PRESS (M) MENU, (R) CHANGE OPTION)"
: PRINT
: HTAB 6
: PRINT "((C) TO CHANGE PARAMETERS) ";
: GET G$
-----
6416 IF G$ = "M" GOTO 6000
-----
6418 IF G$ = "R" GOTO 6424
-----
6420 IF G$ = "C" GOTO 6436
-----
6422 GOTO 6414
-----
```

```
6424  ONERR GOTO 6428
-----
6426  GOSUB 20100
-----
6428  VTAB 5
: CALL - 958
: HTAB 5
: PRINT "RECRUITMENT OPTIONS INPUT MENU"
-----
6430  VTAB 9
: HTAB 3
: PRINT "(1) FIXED RECRUITMENT VECTOR"
: PRINT
: HTAB 3
: PRINT "(2) ADDITIVE (RECRUIT SIZE)"
: PRINT
: HTAB 3
: PRINT "(3) MULTIPLICATIVE (RECRUIT SIZE)"
: PRINT
-----
6432  HTAB 3
: PRINT "(4) ADDITIVE (SYSTEM SIZE)"
: PRINT
: HTAB 3
: PRINT "(5) MULTIPLICATIVE (SYSTEM SIZE)"
-----
6434  GOSUB 20200
: OP = G
-----
6436  IF OP < 1 OR OP > 5 GOTO 6424
-----
6438  IF OP = > 2 GOTO 6470
-----
6440  ONERR GOTO 6458
-----
6442  A = 1
: B$ = "0"
: C = 0
-----
6444  GOSUB 20100
-----
6446  VTAB 5
: CALL - 958
: HTAB 3
: PRINT "RECRUITMENT VECTOR (R) ENTERED IS:"
-----
6448  VTAB 9
: HTAB 13
: PRINT "R1, ";
: FOR I = 1 TO K
```

```

: HTAB 17
: PRINT "C" I": ";#R(I)
: NEXT
-----
6450 GOSUB 20400
-----
6452 IF G$ = "A" GOTO 6000
-----
6454 IF G$ = "R" GOTO 6458
-----
6456 GOTO 6450
-----
6458 VTAB 5
: CALL - 958
: HTAB 2
: PRINT "RECRUITMENT VECTOR (R) FOR OPTION (1)"
: HTAB 4
: PRINT "INPUT ACTUAL RECRUITMENT NUMBERS"
: HTAB 12
: PRINT "(I.E., 52, 15, 3)"
-----
6460 VTAB 10
: HTAB 2
: PRINT "INPUT ROW (R1) AND COLUMN (C1 TO C"K")"
: VTAB 12
: HTAB 12
: PRINT "R1, ";
: II = 11
: FOR I = 1 TO K
-----
6462 HTAB 16
: PRINT "C" I": ";
: INPUT R(I)
-----
6464 IF R(I) < 0 GOTO 6468
-----
6466 NEXT
: GOTO 6444
-----
6468 VTAB (II + I)
: HTAB 21
: FLASH
: PRINT "INVALID NUMBER"
: NORMAL
: II = II + 1
: GOTO 6462
-----
6470 IF OP = 2 OR OP = 4 THEN B$ = "+"
-----
6472 IF OP = 3 OR OP = 5 THEN B$ = "*"

```

```
-----  
6474 IF OP = 4 OR OP = 5 THEN A = - 1  
-----  
6476 ONERR GOTO 6496  
-----  
6478 IF A = - 1 THEN GOSUB 20900  
-----  
6480 GOSUB 20100  
-----  
6482 VTAB 5  
: CALL - 958  
: HTAB 3  
: PRINT "RECRUITMENT VECTOR (R) ENTERED IS:"  
-----  
6484 VTAB 9  
: HTAB 13  
: PRINT "R1, ";  
: FOR I = 1 TO K  
: HTAB 17  
: PRINT "C" I ":";  
: P1 = R(I)  
: GOSUB 20000  
: NEXT  
-----  
6486 GOSUB 20300  
-----  
6488 IF G$ = "A" GOTO 6512  
-----  
6490 IF G$ = "R" GOTO 6496  
-----  
6492 IF G$ = "E" GOTO 6000  
-----  
6494 GOTO 6486  
-----  
6496 VTAB 5  
: HTAB 1  
: CALL - 958  
: PRINT "RECRUITMENT VECTOR (R) FOR OPTIONS (2-5)"  
: VTAB 6  
: HTAB 7  
: PRINT "INPUT HISTORICAL PROPORTIONS"  
: HTAB 10  
: PRINT "(I.E., .74, .21, .05)"  
-----  
6498 VTAB 10  
: HTAB 2  
: PRINT "INPUT ROW (R1) AND COLUMN (C1 TO C" K ")"  
: VTAB 12  
: HTAB 12  
: PRINT "R1, ";
```

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AN APPLE II IMPLEMENTATION OF MAN-MOD MANPOWER PLANNING MODEL. (U)

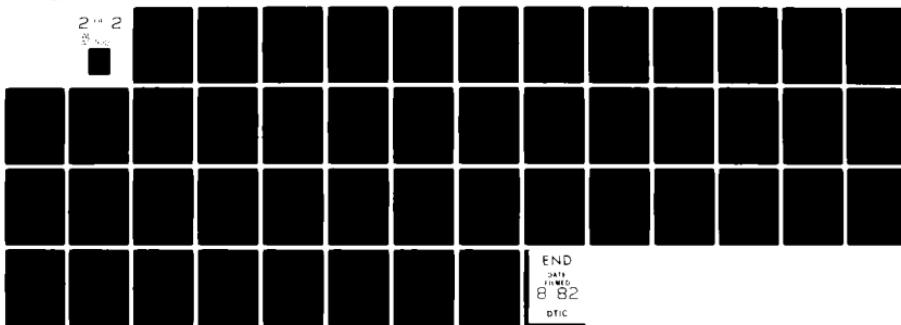
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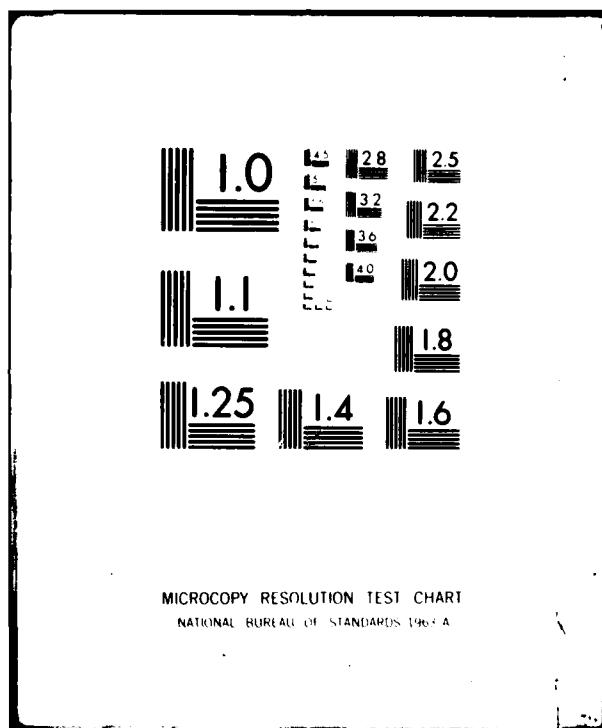


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```
: II = 11
: FOR I = 1 TO K
-----
6500  HTAB 16
: PRINT "C" I": ";
: INPUT R(I)
-----
6502  IF R(I) < 0 OR R(I) > 1 GOTO 6508
-----
6504  NEXT
: RR = 0
: FOR I = 1 TO K
: RR = RR + R(I)
: NEXT
: IF RR < 1 OR RR > 1 GOTO 6510
-----
6506  GOTO 6482
-----
6508  VTAB (II + I)
: HTAB 21
: FLASH
: PRINT "INVALID NUMBER"
: NORMAL
: II = II + 1
: GOTO 6500
-----
6510  GOSUB 20100
: VTAB 11
: HTAB 3
: FLASH
: PRINT "RECRUITMENT VECTOR MUST EQUAL ONE"
: NORMAL
: PRINT
: HTAB 5
: PRINT "PRESS RETURN TO REENTER VECTOR"
: VTAB 24
: HTAB 13
: PRINT "PRESS RETURN ";
: GET GS
: GOTO 6496
-----
6512  IF OP = 4 OR OP = 5 GOTO 6538
-----
6514  GOSUB 20100
-----
6516  VTAB 5
: CALL - 958
: HTAB 4
: PRINT "TOTAL NUMBER (A) ENTERING SYSTEM"
: PRINT
```

```
: HTAB 19
: PRINT "IS"
: VTAB 12
: A$ = STR$ (A)
: HTAB (20 - INT (( LEN (A$) + 2) / 2))
: PRINT "(""A"")"
-----
6518 GOSUB 20300
-----
6520 IF G$ = "A" GOTO 6538
-----
6522 IF G$ = "R" GOTO 6530
-----
6524 IF G$ = "E" GOTO 6000
-----
6526 GOTO 6518
-----
6528 ONERR GOTO 6530
-----
6530 VTAB 5
: CALL - 958
: HTAB 3
: PRINT "NUMBER (A) RECRUITS ENTERING SYSTEM"
-----
6532 VTAB 7
: CALL - 958
: HTAB 13
: INPUT "INPUT (A) ";A
-----
6534 IF A < 0 GOTO 6532
-----
6536 GOTO 6514
-----
6538 IF OP = 3 OR OP = 5 THEN 6560
-----
6540 ONERR GOTO 6554
-----
6542 GOSUB 20100
-----
6544 VTAB 5
: CALL - 958
: HTAB 6
: PRINT "TOTAL NUMBER (C) TO INCREASE"
: PRINT
: HTAB 10
: PRINT "RECRUITS OR SYSTEM IS"
: VTAB 12
: C$ = STR$ (C)
: HTAB (20 - INT (( LEN (C$) + 2) / 2))
: PRINT "(""C"")"
```

```
-----  
6546 GOSUB 20400  
-----  
6548 IF G$ = "A" GOTO 6000  
-----  
6550 IF G$ = "R" GOTO 6554  
-----  
6552 GOTO 6546  
-----  
6554 VTAB 5  
: HTAB 1  
: CALL - 958  
: HTAB 7  
: PRINT "NUMBER TO ADDITIVELY CHANGE"  
: PRINT  
: HTAB 9  
: PRINT "RECRUITS OR SYSTEM SIZE"  
: PRINT  
: HTAB 15  
: PRINT "(I.E., 123)"  
-----  
6556 VTAB 14  
: HTAB 13  
: INPUT "INPUT (C): ";C  
-----  
6558 GOTO 6542  
-----  
6560 ONERR GOTO 6574  
-----  
6562 GOSUB 20100  
-----  
6564 VTAB 5  
: CALL - 958  
: HTAB 4  
: PRINT "MULTIPLICATIVE FACTOR TO INCREASE"  
: PRINT  
: HTAB 10  
: PRINT "RECRUITS OR SYSTEM IS"  
: VTAB 12  
: C$ = STR$ (C)  
: HTAB (20 - INT (( LEN (C$) + 2 ) / 2))  
: PRINT "("C")"  
-----  
6566 GOSUB 20400  
-----  
6568 IF G$ = "A" GOTO 6000  
-----  
6570 IF G$ = "R" GOTO 6574  
-----  
6572 GOTO 6566
```

```
-----  
6574  VTAB 5  
: CALL - 958  
: HTAB 2  
: PRINT "MULTIPLICATIVE FACTOR (C) TO INCREASE"  
: PRINT  
: HTAB 9  
: PRINT "RECRUITS OR SYSTEM SIZE"  
: PRINT  
: HTAB 15  
: PRINT "(I.E., 1.2)"  
-----  
6576  VTAB 14  
: HTAB 13  
: INPUT "INPUT (C): ";C  
-----  
6578  GOTO 6562  
-----  
6600  GOSUB 20100  
-----  
6602  VTAB 4  
: CALL - 958  
: VTAB 9  
: HTAB 2  
: PRINT "NUMBER (T) OF TIME PERIODS ENTERED IS:"  
: PRINT  
: PRINT  
: HTAB 19  
: PRINT "(""T"")"  
-----  
6604  GOSUB 20400  
-----  
6606  IF G$ = "A" GOTO 6000  
-----  
6608  IF G$ = "R" GOTO 6612  
-----  
6610  GOTO 6604  
-----  
6612  ONERR GOTO 6614  
-----  
6614  VTAB 4  
: CALL - 958  
: VTAB 5  
: HTAB 4  
: PRINT "INPUT NUMBER (T) OF TIME PERIODS"  
: PRINT  
: HTAB 14  
: PRINT "PRESS RETURN"  
-----  
6616  VTAB 16
```

```
: HTAB 12
: INPUT "INPUT NUMBER ";T
-----
6618 IF T < 1 GOTO 6614
-----
6620 GOTO 6600
-----
6700 ONERR GOTO 6704
-----
6702 GOSUB 20100
-----
6704 VTAB 4
: CALL - 958
: VTAB 6
: HTAB 8
: PRINT "SELECT PERCENTAGES OPTION"
: PRINT
: HTAB 14
: PRINT "FOR PRINTOUT"
-----
6706 VTAB 12
: HTAB 2
: PRINT "(1) NO CLASS PERCENTAGES (%)"
: PRINT
: HTAB 2
: PRINT "(2) GRADE SIZE AS % OF TOTAL SIZE"
: PRINT
: HTAB 2
: PRINT "(3) GRADE SIZE AS % OF ORIGINAL SIZE"
-----
6708 GOSUB 20200
: Z$ = G$
-----
6710 IF Z$ = "1" OR Z$ = "2" OR Z$ = "3" GOTO 6000
-----
6712 GOTO 6708
-----
6800 ONERR GOTO 6804
-----
6802 GOSUB 20100
-----
6804 VTAB 5
: CALL - 958
: HTAB 2
: PRINT "NUMBER (T) OF TIME PERIODS ENTERED IS:"
: PRINT
: HTAB 19
: PRINT "(""T"")"
-----
6806 VTAB 12
```

```
: CALL - 958
: HTAB 10
: PRINT "EXTEND RANGE ("TA") TO :"
-----
6808 VTAB 22
: HTAB 4
: PRINT "(CANNOT BE LESS THAN "T" PERIODS)"
-----
6810 VTAB 14
: HTAB 14
: PRINT "INPUT +T: ";
: INPUT TA
: IF TA < T GOTO 6806
-----
6812 VTAB 4
: CALL - 958
: VTAB 11
: HTAB 5
: PRINT "TIME (+T) PERIODS EXTENDED TO:"
: PRINT
: PRINT
: HTAB 18
: PRINT "("TA")"
-----
6814 GOSUB 20400
-----
6816 IF G$ = "A" GOTO 6000
-----
6818 IF G$ = "R" GOTO 6800
-----
6820 GOTO 6814
-----
6900 IF K = < 0 GOTO 6000
-----
6902 GOSUB 20100
-----
6904 VTAB 4
: CALL - 958
: PRINT
: HTAB 6
: PRINT "CHANGE INDIVIDUAL ELEMENT OF"
: PRINT
: HTAB 8
: PRINT "THE TRANSITION MATRIX (P)"
: PRINT
: HTAB 17
: PRINT "P(I,J)"
-----
6906 ONERR GOTO 6908
-----
```

6908 VTAB 14
: CALL - 958
: HTAB 11
: PRINT "INPUT ROW NUMBER: ";
: INPUT I
: IF I < 1 OR I > K GOTO 6908

6910 ONERR GOTO 6912

6912 VTAB 17
: CALL - 958
: HTAB 11
: PRINT "INPUT COL NUMBER: ";
: INPUT J
: IF J < 1 OR J > K GOTO 6912

6914 GOSUB 20100

6916 VTAB 6
: CALL - 958
: PRINT "THE PRESENT TRANSITION MATRIX ELEMENT IS"
: VTAB 11
: P1 = P(I,J)
: HTAB 17
: GOSUB 20000

6918 GOSUB 20400

6920 IF GS = "A" GOTO 6000

6922 IF GS = "R" GOTO 6926

6924 GOTO 6918

6926 ONERR GOTO 6930

6928 GOSUB 20100

6930 VTAB 6
: CALL - 958
: HTAB 2
: PRINT "INPUT NEW ROW "I", COL "J" MATRIX ELEMENT"
: II = 11

6932 VTAB (II)
: HTAB 7
: PRINT "INPUT P("I","J") ELEMENT:";
: INPUT P(I,J)

6934 IF P(I,J) = > 0 AND P(I,J) < = 1 GOTO 6942

6936 GOSUB 20500
: IF GS = "E" GOTO 6000

6938 GOTO 6914

6940 VTAB II
: HTAB 29
: FLASH
: PRINT "INVALID NO."
: NORMAL
: II = II + 1
: GOTO 6932

6942 ST = 0
: FOR IP = 1 TO K
: ST = ST + P(I,IP)
: NEXT
: IF ST > 1 GOTO 6936

6944 GOSUB 20100

6946 VTAB 7
: HTAB 7
: PRINT "THE NEW ROW "I", COL "J" ELEMENT"
: PRINT
: HTAB 17
: PRINT "P("I","J") IS"
: VTAB 13
: P1 = P(I,J)
: HTAB 17
: GOSUB 20000

6948 GOSUB 20400

6950 IF GS = "A" GOTO 6000

6952 IF GS = "R" GOTO 6926

6954 GOTO 6948

7000 IF K = < 0 GOTO 6000

7002 GOSUB 20100

7004 VTAB 4
: CALL - 958
: PRINT
: HTAB 5
: PRINT "CHANGE WHOLE ROW OF ELEMENTS OF"

```
: PRINT
: HTAB 8
: PRINT "THE TRANSITION MATRIX (P)"
-----
7006 ONERR GOTO 7008
-----
7008 VTAB 17
: CALL - 958
: HTAB 11
: PRINT "INPUT ROW NUMBER: ";
: INPUT I
: IF I < 1 OR I > K GOTO 7008
-----
7010 GOSUB 20100
-----
7012 VTAB 6
: CALL - 958
: PRINT "THE PRESENT TRANSITION MATRIX ROW "I" IS"
: VTAB 9
: HTAB 17
: PRINT "ROW ";I
: VTAB 11
: FOR J = 1 TO K
: P1 = P(I,J)
: HTAB 14
: PRINT "COL "J" ";
: GOSUB 20000
: NEXT
-----
7014 GOSUB 20400
-----
7016 IF G$ = "A" GOTO 6000
-----
7018 IF G$ = "R" GOTO 7022
-----
7020 GOTO 7014
-----
7022 ONERR GOTO 7026
-----
7024 GOSUB 20100
-----
7026 VTAB 5
: CALL - 958
: HTAB 2
: PRINT "INITIAL FRACTIONAL FLOW MATRIX ROW ";I
: II = 9
-----
7028 VTAB 10
: HTAB 1
: CALL - 958
```

```

: HTAB 13
: PRINT "R" I", ";
: FOR J = 1 TO K
-----
7030   HTAB 17
: PRINT "C" J": ";
: INPUT P(I,J)
-----
7032   IF P(I,J) < 0 OR P(I,J) > 1 GOTO 7038
-----
7034   NEXT
: ST = 0
: FOR IP = 1 TO K
: ST = ST + P(I,IP)
: NEXT
: IF ST > 1 GOTO 7040
-----
7036   GOTO 7010
-----
7038   VTAB (II + J)
: HTAB 21
: FLASH
: PRINT "INVALID NUMBER"
: NORMAL
: II = II + 1
: GOTO 7030
-----
7040   GOSUB 20500
: IF G$ = "E" GOTO 6000
-----
7042   GOTO 7010
-----
7100   GOSUB 20100
-----
7102   VTAB 5
: CALL - 958
: HTAB 6
: PRINT "PRESENT CLASS VECTOR (N) IS:"
-----
7104   VTAB 8
: HTAB 13
: PRINT "R1, ";
: FOR I = 1 TO K
: HTAB 17
: PRINT "C" I": ";#N(I)
: NEXT
-----
7106   VTAB 19
: HTAB 1
: PRINT "PRESS (R) TO CHANGE VECTOR BACK TO THE"

```

```
: HTAB 8
: PRINT "ORIGINAL CLASS VECTOR (N)"
-----
7108 GOSUB 20400
-----
7110 IF G$ = "A" GOTO 6000
-----
7112 IF G$ = "R" GOTO 7116
-----
7114 GOTO 7108
-----
7116 ONERR GOTO 7120
-----
7118 FOR I = 1 TO K
: N(I) = M(I)
: NEXT
-----
7120 GOTO 6000
-----
7200 GOTO 3000
-----
8000 GOSUB 20700
-----
8002 IF G < 1 OR G > 3 GOTO 8000
-----
8004 ON G GOTO 8100,8300,3000
-----
8100 ONERR GOTO 8102
-----
8102 GOSUB 20100
-----
8104 VTAB 3
: HTAB 12
: PRINT "FILE DATA LISTING"
-----
8106 FOR I = 1 TO 39
: PRINT ".";
: NEXT
-----
8108 VTAB 6
: HTAB 1
: INVERSE
: PRINT "DATA FILE NAME:";
: NORMAL
: HTAB 18
: PRINT NFS
-----
8110 VTAB 9
: HTAB 1
: INVERSE
```

```

: PRINT "NUMBER K CLASSES:";
: NORMAL
: HTAB 19
: PRINT K;
: INVERSE
: HTAB 22
: PRINT "TIME T PERIODS:";
: NORMAL
: HTAB 38
: PRINT T
-----
8112  VTAB 12
: HTAB 1
: INVERSE
: PRINT "INITIAL STOCKS:";
: HTAB 22
: PRINT "RECRUITMENT VECTOR:";
: NORMAL
-----
8114  VTAB 14
: HTAB 1
: PRINT "R1, ";
: FOR I = 1 TO K
:   HTAB 5
:   PRINT "C" I": "; #M(I)
: NEXT
-----
8116  VTAB 14
: HTAB 24
: PRINT "R1, ";
-----
8118  IF OP = > 2 AND OP < = 5 GOTO 8122
-----
8120  FOR I = 1 TO K
:   HTAB 28
:   PRINT "C" I": "; #R(I)
: NEXT
: GOTO 8124
-----
8122  FOR I = 1 TO K
:   HTAB 28
:   PRINT "C" I": ";
:   P1 = R(I)
:   GOSUB 20000
: NEXT
-----
8124  INVERSE
: VTAB 24
: HTAB 1
: PRINT "PRESS (C) TO CONTINUE, (E) TO ESCAPE ";

```

```
: GET G$  
: NORMAL  
-----  
8126 IF G$ = "C" GOTO 8132  
-----  
8128 IF G$ = "E" GOTO 3000  
-----  
8130 GOTO 8124  
-----  
8132 GOSUB 20100  
-----  
8134 VTAB 3  
: HTAB 7  
: PRINT "FILE DATA LISTING CONTINUED"  
-----  
8136 FOR I = 1 TO 39  
: PRINT ".";  
: NEXT  
-----  
8138 VTAB 6  
: HTAB 1  
: INVERSE  
: PRINT "PRINTOUT PERCENTAGES OPTION:";  
: NORMAL  
: VTAB 8  
: HTAB 3  
-----  
8140 GOSUB 20860  
-----  
8146 VTAB 11  
: HTAB 1  
: INVERSE  
: PRINT "OPTION SELECTED:";  
: NORMAL  
: VTAB 13  
: HTAB 3  
-----  
8148 GOSUB 20800  
-----  
8158 VTAB 16  
: HTAB 1  
: INVERSE  
: PRINT "OPTION INPUTS:";  
: NORMAL  
: VTAB 18  
: HTAB 3  
-----  
8160 GOSUB 20820  
-----  
8166 VTAB 20
```

```
: HTAB 3
-----
8168 GOSUB 20840
-----
8178 VTAB 24
: HTAB 1
: INVERSE
: PRINT "PRESS (C) TO CONTINUE, (E) TO ESCAPE ";
: GET G$
: NORMAL
-----
8180 IF G$ = "C" GOTO 8186
-----
8182 IF G$ = "E" GOTO 3000
-----
8184 GOTO 8178
-----
8186 GOSUB 20100
-----
8188 VTAB 3
: HTAB 7
: PRINT "FILE DATA LISTING CONTINUED"
-----
8190 FOR I = 1 TO 39
: PRINT ".";
: NEXT
-----
8192 VTAB 7
: INVERSE
: HTAB 10
: PRINT "TRANSITION MATRIX (P)"
: NORMAL
-----
8194 K1 = K
: IF K1 > 5 THEN K1 = 5
-----
8196 VTAB 9
: HTAB 5
: FOR I = 1 TO K1
: PRINT "ROW ";I; SPC( 2 );
: NEXT
-----
8198 VTAB 11
: FOR I = 1 TO K
: HTAB 1
: PRINT "C";I
: NEXT I
-----
8200 II = 4
: FOR I = 1 TO K1
```

```
: VTAB 11
: FOR J = 1 TO K
:   P1 = P(I,J)
:   HTAB (II)
:   GOSUB 20000
: NEXT
: II = II + 7
: NEXT
-----
8202 K2 = K - 5
: IF K2 > 0 GOTO 8206
-----
8204 VTAB 24
: HTAB 8
: INVERSE
: PRINT "PRESS RETURN FOR MENU ";
: GET G$
: NORMAL
: GOTO 3000
-----
8206 VTAB 24
: HTAB 1
: INVERSE
: PRINT "PRESS (C) TO CONTINUE, (E) TO ESCAPE ";
: GET G$
: NORMAL
-----
8208 IF G$ = "C" GOTO 8214
-----
8210 IF G$ = "E" GOTO 3000
-----
8212 GOTO 8206
-----
8214 GOSUB 20100
-----
8216 VTAB 3
: HTAB 7
: PRINT "FILE DATA LISTING CONTINUED"
-----
8218 FOR I = 1 TO 39
: PRINT ".";
: NEXT
-----
8220 VTAB 7
: INVERSE
: HTAB 5
: PRINT "TRANSITION MATRIX (P) CONTINUED"
: NORMAL
-----
8222 VTAB 9
```

```
: HTAB 5
: FOR I = 6 TO K
: PRINT "ROW ";I; SPC( 2 );
: NEXT
-----
8224  VTAB 11
: FOR I = 1 TO K
: HTAB 1
: PRINT "C";I
: NEXT
-----
8226  II = 4
: FOR I = 6 TO K
: VTAB 11
: FOR J = 1 TO K
: P1 = P(I,J)
: HTAB (II)
: GOSUB 20000
: NEXT
: II = II + 7
: NEXT
-----
8228  VTAB 24
: HTAB 8
: INVERSE
: PRINT "PRESS RETURN FOR MENU ";
: GET GS
: NORMAL
: GOTO 3000
-----
8300  ONERR GOTO 8304
-----
8302  GOSUB 20100
-----
8304  VTAB 6
: HTAB 4
: PRINT "DATA LISTING PAPER PRINT ROUTINE"
-----
8306  VTAB 12
: HTAB 6
: PRINT "(1) PAPER COPY ";
: INVERSE
: PRINT "(PRINTER ON)"
: NORMAL
: VTAB 14
: HTAB 6
: PRINT "(2) RETURN TO MENU"
-----
8308  GOSUB 20200
```

8310 IF G < 1 OR G > 2 GOTO 8308

8312 IF G = 2 GOTO 8000

8314 HOME
: VTAB 10
: HTAB 4
: PRINT "PAPER DATA LISTING BEING PRINTED"

8316 GOSUB 20600
: GOTO 3000

9000 GOSUB 20100

9002 VTAB 7
: HTAB 6
: PRINT "DO YOU WISH TO SAVE DATA FILE"
: PRINT
: HTAB (19 - INT (LEN (NFS) / 2))
: PRINT Q\$;NFS;Q\$

9004 VTAB 14
: HTAB 17
: PRINT "(1) YES"
: PRINT
: HTAB 17
: PRINT "(2) NO"

9006 GOSUB 20200

9008 IF G < 1 OR G > 2 GOTO 9006

9010 ON G GOTO 9100,3000

9100 GOSUB 20100

9102 VTAB 8
: HTAB 9
: PRINT "INPUT DISK DRIVE NUMBER"
: PRINT
: PRINT
: HTAB 12
: PRINT "(1) DISK DRIVE 1"
: PRINT
: HTAB 12
: PRINT "(2) DISK DRIVE 2"
: PRINT
: HTAB 12
: PRINT "(3) ESCAPE TO MENU"

```
9104  GOSUB 20200
-----
9106  IF G < 1 OR G > 3 GOTO 9104
-----
9108  DN = G
-----
9110  IF G = 3 THEN 1006
-----
9112  HOME
: VTAB 11
: HTAB 7
: PRINT "<DATA FILE IS BEING SAVED>"
```

```
9114  FOR I = 1 TO K
:   N(I) = M(I)
:   NN(I) = N(I)
: NEXT
: FOR I = 1 TO K
:   FOR J = 1 TO K
:     PP(I,J) = P(I,J)
:   NEXT
: NEXT
: FOR I = 1 TO K
:   RR(I) = R(I)
: NEXT
```

```
9116  ONERR GOTO 9100
-----
9118  PRINT
: PRINT DS;"OPEN"NF$" ,D";DN
```

```
9120  PRINT DS;"DELETE";NF$
```

```
9122  PRINT DS;"OPEN";NF$
```

```
9124  PRINT DS;"WRITE";NF$
```

```
9126  PRINT K
: FOR I = 1 TO 9
:   PRINT NN(I)
: NEXT
: FOR I = 1 TO 9
:   FOR J = 1 TO 9
:     PRINT PP(I,J)
:   NEXT
: NEXT
: FOR I = 1 TO 9
:   PRINT RR(I)
: NEXT
: PRINT A
```

```
: PRINT B$  
: PRINT C  
: PRINT T  
: PRINT Z$  
: PRINT OP  
: PRINT DO  
: PRINT DS;"CLOSE"  
-----  
9128 GOTO 1006  
-----  
9200 GOSUB 20100  
-----  
9202 VTAB 5  
: HTAB 13  
: PRINT "<EXIT ROUTINE>"  
: HTAB 13  
: PRINT "-----"  
-----  
9204 VTAB 11  
: HTAB 8  
: PRINT "(1) RETURN TO MAIN MENU"  
: PRINT  
-----  
9206 HTAB 8  
: PRINT "(2) EXIT PROGRAM"  
-----  
9208 GOSUB 20200  
-----  
9210 IF G < 1 OR G > 2 GOTO 9208  
-----  
9212 ON G GOTO 1006,9214  
-----  
9214 HOME  
: VTAB 11  
: HTAB 7  
: PRINT "MAN-MOD ANALYSIS COMPLETED"  
: PRINT  
: HTAB 5  
: PRINT "TURN OFF COMPUTER AND FILE DISK"  
: FOR I = 1 TO 5000  
: NEXT  
: HOME  
: END  
-----  
10000 ONERR GOTO 1000  
-----  
10002 GOSUB 20100  
-----  
10004 VTAB 8  
: HTAB 4
```

```

: PRINT "(1) CALCULATE ALL "T" PERIODS"
: PRINT
: HTAB 4
: PRINT "(2) CALCULATE LAST TIME PERIOD "T
: PRINT
: HTAB 4
: PRINT "(3) EXTEND CALCULATION RANGE"
: PRINT
: HTAB 4
: PRINT "(4) RETURN TO MENU"
-----
10006 GOSUB 20200
: PR = G
: IF G < 1 OR G > 4 GOTO 10006
-----
10008 IF G = 4 GOTO 3000
-----
10009 IF PR = 3 GOTO 10200
-----
10010 GOSUB 20700
: PO = G
: IF G < 1 OR G > 3 GOTO 10010
-----
10012 IF PO = 3 GOTO 10000
-----
10014 IF PR = 1 OR PR = 2 THEN FOR I = 1 TO K
* : N(I) = M(I)
* : NEXT
-----
10016 IF PR = 2 THEN SP = T
-----
10018 IF PR = 3 GOTO 10027
-----
10020 IF PO = 2 GOTO 10032
-----
10022 GOTO 10300
-----
10024 IF TA < = T GOTO 10030
-----
10025 TT = TA - T - 1
: T = TA
-----
10026 IF PR = 3 GOTO 10010
-----
10027 IF PO = 1 THEN PR = 2
* : GOTO 10304
-----
10028 GOTO 10032
-----
10030 HOME

```

```
: VTAB 9
: HTAB 12
: FLASH
: PRINT "INVALID +T VALUE"
: NORMAL
: FOR I = 1 TO 1500
: NEXT
: GOTO 10000
```

```
10032 GOSUB 20100
: VTAB 5
: HTAB 13
: PRINT "TURN PRINTER ON"
: PRINT
: HTAB 6
: PRINT "(NOT REQUIRED WITH SILENTYPE)"
: VTAB 10
: HTAB 15
: PRINT "ALIGN PAPER"
: VTAB 14
: HTAB 7
: PRINT "PRINTOUT DEFAULTS TO SLOT 1"
```

```
10034 VTAB 23
: FOR I = 1 TO 39
: PRINT "'";
: NEXT
: VTAB 24
: HTAB 7
: PRINT "PRESS RETURN TO CONTINUE ";
: GET G$
```

```
10036 HOME
: VTAB 9
: HTAB 7
: PRINT "<PRINT ROUTINE IN PROCESS>"
: VTAB 11
: HTAB 2
: PRINT "<PRESS (E) TO ESCAPE PRINTING ROUTINE>"
: GOSUB 10600
```

```
10038 IF PR = 2 OR PR = 3 THEN HOME
```

```
10040 IF PR = 3 GOTO 10306
```

```
10042 GOTO 10300
```

```
10200 GOSUB 20100
```

```
10202 VTAB 4
```

```
: HTAB 4
: PRINT "PRESENT TIME (T) PERIODS ARE: "T
-----
10204 VTAB 6
: HTAB 4
: PRINT "EXTENDED RANGE (+T) INPUT IS: "TA
-----
10206 VTAB 9
: INVERSE
: HTAB 1
: PRINT "(+T CANNOT BE LESS THAN OR EQUAL TO T)"
: NORMAL
-----
10208 VTAB 12
: HTAB 4
: PRINT "(1) CONTINUE FLOWS TO "TA
: PRINT
: HTAB 4
: PRINT "(2) CONTINUE FLOW, PRINT ONLY "TA
: PRINT
: HTAB 4
: PRINT "(3) +T CHANGE ROUTINE"
: PRINT
: HTAB 4
: PRINT "(4) RETURN TO MENU"
-----
10210 GOSUB 20200
: IF G < 1 OR G > 4 GOTO 10210
-----
10212 IF G = 2 THEN SP = TA
-----
10214 ON G GOTO 10024,10024,6000,10000
-----
10300 T1 = - 1
: T2 = 0
: TT = T
-----
10302 IF P0 = 2 GOTO 10306
-----
10304 GOSUB 10400
-----
10306 IF PR = 2 OR PR = 3 THEN VTAB 11
* : HTAB 13
* : FLASH
* : PRINT "PROGRAM WORKING"
* : NORMAL
-----
10308 POKE - 16368,0
-----
10310 FOR S = 0 TO TT
```

```
-----  
10312  IF T1 = - 1 THEN R1 = 0  
* : GOTO 10320  
-----  
10314  GOSUB 10800  
-----  
10316  FOR I = 1 TO K  
: XM(I) = 0  
: FOR J = 1 TO K  
: XM(I) = N(J) * P(J,I) + XM(I)  
: NEXT  
: NEXT  
-----  
10318  FOR I = 1 TO K  
: N(I) = XM(I) + RM(I)  
: NEXT  
-----  
10320  D = .00000001  
: FOR I = 1 TO K  
: D = D + N(I)  
: NEXT  
: T1 = T1 + 1  
: IF T1 = T2 GOTO 10324  
-----  
10322  GOTO 10338  
-----  
10324  T2 = T2 + 1  
-----  
10326  IF SP > T1 GOTO 10338  
-----  
10328  IF PO = 2 GOTO 10700  
-----  
10330  GOSUB 10500  
-----  
10332  VTAB 24  
: HTAB 1  
: PRINT "PRESS (C) TO CONTINUE, (E) TO ESCAPE ";  
: GET GS  
: IF GS = "E" GOTO 3000  
-----  
10334  GOTO 10338  
-----  
10336  X = PEEK (- 16384)  
: IF X = 197 GOTO 3000  
-----  
10338  NEXT S  
: SP = 0  
-----  
10340  GOTO 10000  
-----
```

```
10400 GOSUB 20100
: VTAB 5
: HTAB 11
: PRINT "TRANSITIONAL FLOWS"
-----
10402 IF Z$ = "2" OR Z$ = "3" GOTO 10408
-----
10404 VTAB 7
: HTAB 2
: PRINT "TIME";
: HTAB 8
: PRINT "CLASS";
: HTAB 15
: PRINT "STOCKS-N";
: HTAB 25
: PRINT "RECRUITMENT"
-----
10406 VTAB 8
: HTAB 1
: FOR I = 1 TO 39
: PRINT "-";
: NEXT
: PRINT
: RETURN
-----
10408 VTAB 7
: HTAB 2
: PRINT "TIME";
: HTAB 8
: PRINT "CLASS";
: HTAB 15
: PRINT "STOCKS(PERCENT)";
: HTAB 32
: PRINT "RECRUIT"
-----
10410 VTAB 8
: FOR I = 1 TO 39
: PRINT "-";
: NEXT
: PRINT
: RETURN
-----
10500 IF Z$ = "2" GOTO 10516
-----
10502 IF Z$ = "3" GOTO 10522
-----
10504 IF OP = > 2 GOTO 10508
-----
10506 VTAB 10
: CALL - 958
```

```
: HTAB 2
: PRINT T1;
: FOR J = 1 TO K
:   HTAB 10
:   PRINT J;
:   HTAB 16
:   JJ = N(J) + .5
:   PRINT # INT (JJ);
:   HTAB 28
:   PRINT #R(J)
: NEXT
: VTAB (11 + K)
: HTAB 8
: PRINT "TOTAL";
: HTAB 16
: PRINT #(D + .5);
: GOTO 10512
```

```
10508 VTAB 10
: CALL - 958
: HTAB 2
: PRINT T1;
: FOR J = 1 TO K
:   HTAB 10
:   PRINT J;
:   HTAB 16
:   JJ = N(J) + .5
:   PRINT # INT (JJ);
:   HTAB 28
:   RX = R1 * R(J)
:   PRINT # INT (RX + .5)
: NEXT
```

```
10510 VTAB (11 + K)
: HTAB 8
: PRINT "TOTAL";
: HTAB 16
: PRINT #(D + .5);
```

```
10512 HTAB 28
: PRINT #(R1 + .5)
```

```
10514 VTAB (13 + K)
: HTAB 1
: FOR I = 1 TO 36
:   PRINT "-";
: NEXT
: RETURN
```

```
10516 IF OP = > 2 GOTO 10520
```

```
-----  
10518 VTAB 10  
: CALL - 958  
: HTAB 2  
: PRINT T1;  
: FOR J = 1 TO K  
:   HTAB 10  
:   PRINT J;  
:   HTAB 14  
:   JJ = N(J) + .5  
:   PRINT "FOR"6,0;# INT (JJ); SPC( 3);  
:   N1 = 100 * N(J) / D  
:   PRINT "FOR"3,0;"("# INT (N1 + .5)");  
:   HTAB 32  
:   PRINT "FOR"6,0;#R(J)  
: NEXT  
: GOTO 10528  
-----
```

```
10520 VTAB 10  
: CALL - 958  
: HTAB 2  
: PRINT T1;  
: FOR J = 1 TO K  
:   HTAB 10  
:   PRINT J;  
:   HTAB 14  
:   JJ = N(J) + .5  
:   PRINT "FOR"6,0;# INT (JJ); SPC( 3);  
:   N1 = 100 * N(J) / D  
:   PRINT "FOR"3,0;"("# INT (N1 + .5)");  
:   HTAB 32  
:   RX = R1 * R(J)  
:   PRINT "FOR"6,0;# INT (RX + .5)  
: NEXT  
: GOTO 10528  
-----
```

```
10522 IF OP = > 2 GOTO 10526  
-----
```

```
10524 VTAB 10  
: CALL - 958  
: HTAB 2  
: PRINT T1;  
: FOR J = 1 TO K  
:   HTAB 10  
:   PRINT J;  
:   HTAB 14  
:   JJ = N(J) + .5  
:   PRINT "FOR"6,0;# INT (JJ); SPC( 3);  
:   N1 = 100 * N(J) / M(J)  
:   PRINT "FOR"3,0;"("# INT (N1 + .5)");  
-----
```

```

: HTAB 32
: PRINT "FOR"6,0;#R(J)
: NEXT
: GOTO 10528
-----
10526 VTAB 10
: CALL - 958
: HTAB 2
: PRINT T1;
: FOR J = 1 TO K
: HTAB 10
: PRINT J;
: HTAB 14
: JJ = N(J) + .5
: PRINT "FOR"6,0;# INT (JJ); SPC( 3);
: N1 = 100 * N(J) / M(J)
: PRINT "FOR"3,0;"(# INT (N1 + .5))";
: HTAB 32
: RX = R1 * R(J)
: PRINT "FOR"6,0;# INT (RX + .5)
: NEXT
-----
10528 VTAB (11 + K)
: HTAB 8
: PRINT "TOTAL";
: HTAB 14
: N1 = 100 * D / DO
: PRINT #(D + .5); SPC( 3); "FOR"3,0;"(# INT (N1 + .5
))";
: HTAB 32
: PRINT "FOR"6,0;#(R1 + .5)
-----
10530 VTAB (13 + K)
: HTAB 1
: FOR I = 1 TO 39
: PRINT "-";
: NEXT
: RETURN
-----
10600 PR# 1
: PRINT
: PRINT
-----
10602 HTAB 10
: PRINT "DATA FILE NAME...:";
: POKE 36,40
: PRINT "("NFS")"
: PRINT
: PRINT
-----
```

```
10604 HTAB 10
: PRINT "TRANSITIONAL FLOWS"
: PRINT
: PRINT
-----
10606 IF Z$ = "2" OR Z$ = "3" GOTO 10612
-----
10608 HTAB 10
: PRINT "TIME";
: HTAB 20
: PRINT "CLASS";
: HTAB 30
: PRINT "STOCKS (N)";
: POKE 36,46
: PRINT "RECRUITMENT"
-----
10610 HTAB 10
: FOR I = 1 TO 48
: PRINT "=";
: NEXT
: PRINT
: GOTO 10616
-----
10612 HTAB 10
: PRINT "TIME";
: HTAB 20
: PRINT "CLASS";
: HTAB 30
: PRINT "STOCKS (N)";
: POKE 36,43
: PRINT "(PERCENT)";
: POKE 36,57
: PRINT "RECRUITMENT"
-----
10614 HTAB 10
: FOR I = 1 TO 59
: PRINT "=";
: NEXT
: PRINT
-----
10616 VC = 10
: PR# 0
: RETURN
-----
10700 PR# 1
: IF Z$ = "2" GOTO 10720
-----
10702 IF Z$ = "3" GOTO 10726
-----
10704 IF OP = > 2 GOTO 10708
```

```
-----  
10706 HTAB 10  
: PRINT T1;  
: FOR J = 1 TO K  
: HTAB 23  
: PRINT J;  
: HTAB 31  
: JJ = N(J) + .5  
: PRINT # INT (JJ);  
: POKE 36,49  
: PRINT #R(J)  
: NEXT  
: PRINT  
: GOTO 10710  
-----  
10708 HTAB 10  
: PRINT T1;  
: FOR J = 1 TO K  
: HTAB 23  
: PRINT J;  
: HTAB 31  
: JJ = N(J) + .5  
: PRINT # INT (JJ);  
: POKE 36,49  
: RX = R1 * R(J)  
: PRINT # INT (RX + .5)  
: NEXT  
: PRINT  
-----  
10710 HTAB 20  
: PRINT "TOTAL";  
: HTAB 31  
: PRINT #(D + .5);  
: POKE 36,49  
: PRINT #(R1 + .5)  
-----  
10712 HTAB 10  
: FOR I = 1 TO 48  
: PRINT "-";  
: NEXT  
: PRINT  
-----  
10714 VC = VC + (K + 3)  
: IF VC < 54 GOTO 10720  
-----  
10716 FOR I = 1 TO (66 - VC)  
: PRINT  
: NEXT  
-----  
10718 GOSUB 10600
```

```

: PR# 0
: GOTO 10336
-----
10720 IF OP = > 2 GOTO 10724
-----
10722 HTAB 10
: PRINT T1;
: FOR J = 1 TO K
: HTAB 22
: PRINT J;
: HTAB 31
: JJ = N(J) + .5
: PRINT "FOR"6,0;# INT (JJ);
: POKE 36,45
: N1 = 100 * N(J) / D
: PRINT "FOR"3,0;"(# INT (N1 + .5))";
: POKE 36,59
: PRINT "FOR"6,0;#R(J)
: NEXT
: PRINT
: GOTO 10732
-----
10724 HTAB 10
: PRINT T1;
: FOR J = 1 TO K
: HTAB 22
: PRINT J;
: HTAB 31
: JJ = N(J) + .5
: PRINT "FOR"6,0;# INT (JJ);
: POKE 36,45
: N1 = 100 * N(J) / D
: PRINT "FOR"3,0;"(# INT (N1 + .5))";
: POKE 36,59
: RX = R1 * R(J)
: PRINT "FOR"6,0;# INT (RX + .5)
: NEXT
: PRINT
: GOTO 10732
-----
10726 IF OP = > 2 GOTO 10730
-----
10728 HTAB 10
: PRINT T1;
: FOR J = 1 TO K
: HTAB 22
: PRINT J;
: HTAB 31
: JJ = N(J) + .5
: PRINT "FOR"6,0;# INT (JJ);

```

```

: POKE 36,45
: N1 = 100 * N(J) / M(J)
: PRINT "FOR"3,0;"(# INT (N1 + .5))";
: POKE 36,59
: PRINT "FOR"6,0;#R(J)
: NEXT
: PRINT
: GOTO 10732
-----
10730 HTAB 10
: PRINT T1;
: FOR J = 1 TO K
:   HTAB 22
:   PRINT J;
:   HTAB 31
:   JJ = N(J) + .5
:   PRINT "FOR"6,0;# INT (JJ);
:   POKE 36,45
:   N1 = 100 * N(J) / M(J)
:   PRINT "FOR"3,0;"(# INT (N1 + .5))";
:   POKE 36,59
:   RX = R1 * R(J)
:   PRINT "FOR"6,0;# INT (RX + .5)
: NEXT
: PRINT
-----
10732 HTAB 20
: PRINT "TOTAL";
: HTAB 31
: PRINT "FOR"6,0;#(D + .5);
: N1 = 100 * D / DO
: POKE 36,45
: PRINT "FOR"3,0;"(# INT (N1 + .5))";"FOR"6,0;
: POKE 36,59
: PRINT #(R1 + .5)
-----
10734 HTAB 10
: FOR I = 1 TO 58
:   PRINT "-";
: NEXT
: PRINT
-----
10736 VC = VC + (K + 3)
: IF VC < 54 GOTO 10742
-----
10738 FOR I = 1 TO (66 - VC)
:   PRINT
: NEXT
-----
10740 GOSUB 10600

```

```
-----  
10742 PR# 0  
: GOTO 10336  
-----  
10800 IF A = - 1 GOTO 10806  
-----  
10802 IF B$ = "0" GOTO 10828  
-----  
10804 GOTO 10816  
-----  
10806 R1 = 0  
: FOR J = 1 TO K  
: R1 = R1 + N(J) * W(J)  
: NEXT  
-----  
10808 IF B$ = "*" GOTO 10812  
-----  
10810 R1 = R1 + C  
: GOTO 10814  
-----  
10812 R1 = R1 + D * (C - 1)  
-----  
10814 FOR J = 1 TO K  
: RM(J) = R1 * R(J)  
: NEXT  
: GOTO 10830  
-----  
10816 IF A = 0 THEN A = 1  
-----  
10818 R1 = A  
-----  
10820 FOR J = 1 TO K  
: RM(J) = R1 * R(J)  
: NEXT  
-----  
10822 IF B$ = "*" GOTO 10826  
-----  
10824 A = A + C  
: GOTO 10830  
-----  
10826 A = A * C  
: GOTO 10830  
-----  
10828 FOR J = 1 TO K  
: RM(J) = R(J)  
: NEXT  
: R1 = 0  
: FOR J = 1 TO K  
: R1 = R1 + RM(J)  
: NEXT
```

10830 RETURN

20000 P1 = P1 * 10000
: PBD = INT (P1)
: PAD = P1 - PBD
: ROUND = INT (PAD + .5)
: PBD = PBD + ROUND

20002 IF PBD = 10000 GOTO 20014

20004 IF PBD = 0 GOTO 20016

20006 PBD\$ = STR\$ (PBD)
: LS = LEN (PBD\$)

20008 IF LS = 4 GOTO 20018

20010 LZ = 4 - LS
: ZEROS\$ = "0000"
: ZEROS\$ = LEFT\$ (ZEROS\$, LZ)

20012 PRINT ".;ZEROS\$;PBD\$
: GOTO 20020

20014 PRINT "1.0000"
: GOTO 20020

20016 PRINT ".0000"
: GOTO 20020

20018 PRINT ".;PBD\$
: GOTO 20020

20020 RETURN

20050 P1 = P1 * 10000
: PBD = INT (P1)
: PAD = P1 - PBD
: ROUND = INT (PAD + .5)
: PBD = PBD + ROUND

20052 IF PBD = 10000 GOTO 20064

20054 IF PBD = 0 GOTO 20066

20056 PBD\$ = STR\$ (PBD)
: LS = LEN (PBD\$)

20058 IF LS = 4 GOTO 20068

```
-----  
20060 LZ = 4 - LS  
: ZEROS = "0000"  
: ZEROS = LEFT$ (ZEROS,LZ)  
-----  
20062 PRINT ". "; ZEROS; PBD$;  
: GOTO 20070  
-----  
20064 PRINT "1.0000";  
: GOTO 20070  
-----  
20066 PRINT ".0000";  
: GOTO 20070  
-----  
20068 PRINT ". "; PBD$;  
: GOTO 20070  
-----  
20070 RETURN  
-----  
20100 TEXT  
: HOME  
: INVERSE  
: VTAB 1  
: HTAB 1  
: PRINT " * MAN-MOD TRANSITION MATRIX PROGRAM * "  
: NORMAL  
: RETURN  
-----  
20200 VTAB 23  
: HTAB 1  
: FOR I = 1 TO 39  
: PRINT "'";  
: NEXT  
: PRINT  
: HTAB 12  
: PRINT "PRESS SELECTION ";  
: GET GS  
: G = VAL (GS)  
: RETURN  
-----  
20300 VTAB 22  
: HTAB 2  
: PRINT "(PRESS (A) TO ACCEPT, (R) TO REENTER)"  
: PRINT  
: VTAB 24  
: HTAB 12  
: PRINT "((E) TO ESCAPE) ";  
: GET GS  
: RETURN  
-----
```

```
20400 VTAB 24
: HTAB 1
: PRINT "(PRESS (A) TO ACCEPT, (R) TO REENTER)";
: GET GS
: RETURN
-----
20500 VTAB 4
: HTAB 1
: CALL - 958
: VTAB 5
: HTAB 2
: FLASH
: PRINT "ROW PROBABILITIES SUM GREATER THAN 1"
: NORMAL
: VTAB 12
: HTAB 8
: PRINT "VERIFY INPUTS AND REENTER"
-----
20502 VTAB 10
: HTAB 3
: PRINT "(C) TO CONTINUE AND REENTER INPUT"
: PRINT
: HTAB 3
: PRINT "(E) ESCAPE INPUT ROUTINE TO MENU"
-----
20504 VTAB 16
: HTAB 3
: PRINT "(WITH ESCAPE (E) ALL PREVIOUS INPUTS"
: HTAB 3
: PRINT "ARE ACCEPTED, REMAINING INPUTS MAY BE"
: HTAB 3
: PRINT "ENTERED THROUGH THE CHANGE ROUTINE)"
-----
20506 VTAB 24
: HTAB 1
: PRINT "PRESS (C) TO CONTINUE, (E) TO ESCAPE ";
: GET GS
-----
20508 IF GS = "C" OR GS = "E" GOTO 20512
-----
20510 GOTO 20506
-----
20512 RETURN
-----
20600 PR# 1
: PRINT
: PRINT
: PRINT
: HTAB 5
: FOR I = 1 TO 25
```

```
: PRINT "-";
: NEXT
: PRINT
-----
20602 HTAB 5
: PRINT "MAN-MOD DATA FILE LISTING"
: HTAB 5
: FOR I = 1 TO 25
:   PRINT "-";
: NEXT
: PRINT
: PRINT
: PRINT
-----
20604 HTAB 5
: PRINT "DATA FILE NAME IS...:";
: HTAB 35
: PRINT NFS
: PRINT
: PRINT
: HTAB 5
: PRINT "NUMBER (K) CLASSES...:";
: HTAB 35
: PRINT "(""K"")"
: PRINT
: PRINT
-----
20606 HTAB 5
: PRINT "TIME (T) PERIODS...:";
: HTAB 35
: PRINT "(""T"")"
: PRINT
: PRINT
: HTAB 5
: PRINT "PERCENTAGES OPTION...:";
: HTAB 35
: GOSUB 20860
: PRINT
: PRINT
-----
20608 HTAB 5
: PRINT "OPTION SELECTED IS...:";
: HTAB 35
: GOSUB 20800
: PRINT
: PRINT
: HTAB 5
: PRINT "OPTION INPUTS.....:";
: HTAB 35
: GOSUB 20820
```

```
: PRINT
: HTAB 35
: GOSUB 20840
: PRINT
: PRINT
-----
20610 HTAB 5
: PRINT "INITIAL STOCK (N) VECTOR AND RECRUITMENT (R)
  VECTOR"
: PRINT
: PRINT
-----
20612 HTAB 16
: FOR I = 1 TO K
:   PRINT SPC( 1); "COL "; I; SPC( 1);
: NEXT
: PRINT
: PRINT
-----
20614 HTAB 5
: PRINT "VECTOR N:";
: HTAB 16
: FOR I = 1 TO K
:   PRINT #M(I); SPC( 1);
: NEXT
: PRINT
: PRINT
-----
20616 HTAB 5
: PRINT "RECRUIT R:";
-----
20618 IF OP = 1 GOTO 20622
-----
20620 HTAB 16
: FOR I = 1 TO K
:   P1 = R(I)
:   GOSUB 20050
:   PRINT SPC( 1);
: NEXT
: PRINT
: PRINT
: PRINT
: GOTO 20624
-----
20622 HTAB 16
: FOR I = 1 TO K
:   PRINT #R(I); SPC( 1);
: NEXT
: PRINT
: PRINT
```

```
: PRINT
-----
20624 HTAB 5
: PRINT "TRANSITIONAL FLOW MATRIX (P)"
: PRINT
: PRINT
-----
20626 HTAB 16
: FOR I = 1 TO K
: PRINT SPC( 1 );"COL ";I; SPC( 1 );
: NEXT
: PRINT
: PRINT
-----
20628 FOR I = 1 TO K
: HTAB 5
: PRINT "ROW ("I")";
: HTAB 16
: FOR J = 1 TO K
: P1 = P(I,J)
: GOSUB 20050
: PRINT SPC( 1 );
: NEXT
: PRINT
: NEXT
: PRINT
: PRINT
: PRINT
-----
20630 K3 = 9 - K
: K4 = 11 + K3
: FOR I = 1 TO K4
: PRINT
: NEXT
-----
20632 PR# 0
: RETURN
-----
20700 GOSUB 20100
-----
20702 VTAB 6
: HTAB 7
: PRINT "CHOOSE DESIRED DATA LISTING"
-----
20704 VTAB 11
: HTAB 10
: PRINT "(1) SCREEN DISPLAY"
: VTAB 13
: HTAB 10
: PRINT "(2) PAPER COPY"
```

```
: VTAB 15
: HTAB 10
: PRINT "(3) RETURN TO MENU"
-----
20708 GOSUB 20200
-----
20710 RETURN
-----
20800 IF OP = 1 THEN PRINT "FIXED RECRUIT VECTOR"
-----
20802 IF OP = 2 THEN PRINT "ADDITIVE (RECRUIT SIZE)"
-----
20804 IF OP = 3 THEN PRINT "MULTIPLICATIVE (RECRUIT SIZE)"
-----
20806 IF OP = 4 THEN PRINT "ADDITIVE (SYSTEM SIZE)"
-----
20808 IF OP = 5 THEN PRINT "MULTIPLICATIVE (SYSTEM SIZE)"
-----
20810 RETURN
-----
20820 IF OP = 1 THEN PRINT "NOT APPLICABLE"
-----
20822 IF OP = 2 OR OP = 3 THEN PRINT "NUMBER ENTERING (";A
;)"
-----
20824 IF OP = 4 OR OP = 5 THEN PRINT "CALCULATES TOTAL NET
NUMBER"
-----
20826 RETURN
-----
20840 IF OP = 1 THEN PRINT "ALL ENTER CLASS 1"
-----
20842 IF OP = 2 THEN PRINT "NUMBER TO INCREASE ("C")"
-----
20844 IF OP = 3 OR OP = 5 THEN PRINT "MULTIPLICATIVE FACTO
R ("C")"
-----
20846 IF OP = 4 THEN PRINT "TO INCREASE SYSTEM BY (";C;")"
-----
20848 RETURN
-----
20860 IF Z$ = "1" THEN PRINT "NO CLASS PERCENTAGES (%)"
-----
20862 IF Z$ = "2" THEN PRINT "GRADE SIZE AS % OF TOTAL SIZ
E"
-----
20864 IF Z$ = "3" THEN PRINT "GRADE SIZE AS % OF ORIGINAL
SIZE"
-----
20866 RETURN
```

```
-----  
20900 FOR I = 1 TO K  
: W(I) = 1  
: FOR J = 1 TO K  
: W(I) = W(I) - P(I,J)  
: NEXT  
: NEXT  
: RETURN
```

APPENDIX D

MAN-MOD/LINKER MODULE PROGRAM LISTING

The MAN-MOD/LINKER module is a public domain machine language routine. It allows module chaining. The program listing was done by a memory listing routine.

*2F18.308F

2F18- 44 20 50 52 4F 47 52 41
2F20- 4D 2E 20 49 54 20 44 45
2F28- 54 45 52 4D 49 4E 45 53
2F30- 20 54 48 45 20 4E 55 40
2F38- 42 45 52 20 4F 46 22 34
2F40- A2 31 30 3A BA 22 50 45
2F48- 52 49 4F 44 53 20 46 4F
2F50- 52 20 57 48 49 43 48 20
2F58- 43 41 4C 43 55 4C 41 54
2F60- 49 4F 4E 53 20 41 52 45
2F68- 20 54 4F 20 42 45 22 00
2F70- 03 30 22 0D A2 31 32 3A
2F78- BA 22 50 45 52 46 4F 52
2F80- 4D 45 44 2E 20 20 43 41
2F88- 4C 43 55 4C 41 54 49 4F
2F90- 4E 53 20 4D 41 59 20 42
2F98- 45 20 44 4F 4E 45 20 52
2FA0- 45 2D 22 3A A2 31 34 3A
2FA8- BA 22 50 45 41 54 45 44
2FB0- 4C 59 2C 20 20 41 4E 44
2FB8- 20 43 48 41 4E 47 45 53
2FC0- 20 4F 52 20 4D 4F 44 49
2FC8- 46 49 43 41 54 49 4F 4E
2FD0- 53 22 3A A2 31 36 3A BA
2FD8- 22 54 4F 20 50 41 52 41
2FE0- 4D 45 54 45 52 53 20 43
2FE8- 41 4E 20 42 45 20 49 40
2FF0- 50 4C 45 4D 45 4E 54 45
2FF8- 44 20 54 48 52 4F 55 47
3000- 48 22 00 79 30 24 0D A2
3008- 31 38 3A BA 22 54 48 45
3010- 20 4D 41 49 4E 20 4D 45
3018- 4E 55 2E 20 54 48 45 20
3020- 55 53 45 52 20 4D 41 59
3028- 20 49 4E 43 52 45 41 53
3030- 45 20 54 48 45 22 3A A2
3038- 32 30 3A BA 22 4E 55 40
3040- 42 45 52 20 4F 46 20 50
3048- 43 52 49 4F 44 53 20 45
3050- 49 54 48 45 52 20 42 59
3058- 20 55 53 49 4E 47 20 27
3060- 54 49 4D 45 22 3A B0 39
3068- 33 30 30 3A AD 47 24 00
3070- 22 4D 22 AB 33 30 30 30
3078- 00 0E 31 26 0D B0 39 30
3080- 30 30 3A A2 34 3A BA 22
3088- 28 54 29 27 20 4F 52 20

X3090.30E0

3090- 54 48 45 20 27 45 58 34
3098- 20 52 41 4E 47 45 20 28
30A0- 54 27 20 43 48 4F 49 43
30A8- 45 20 4F 4E 20 54 48 45
30B0- 22 3A A2 36 3A BA 22 54
30B8- 48 45 20 43 48 41 4E 47
30C0- 45 20 4F 52 20 4D 4F 44
30C8- 49 46 59 20 4D 45 4E 55
30D0- 2E 20 20 54 49 4D 45 20
30D8- 50 45 52 49 4F 44 22 3A
30E0- A2

APPENDIX E

MAN-MOD/FORMATTER MODULE PROGRAM LISTING

The MAN-MOD/FORMATTER module is a print using routine allowing for real and integer numbers to be formatted. It is a modified version of PRINT II, a Computer Systems Design copyrighted program. Permission has been obtained to utilize the modified routine for MAN-MOD; any other use of the routine is prohibited. The program listing was done by a memory listing routine.

*9A07.9B7F

9A07- 20
9A08- 8D 9A 20 81 9A 20 29 9A
9A10- 20 20 9A A9 4C 85 BA A9
9A18- D4 85 BB A9 9C 85 BC 60
9A20- A9 00 85 E3 A9 20 85 F9
9A28- 60 A2 01 20 60 9A A2 2A
9A30- 20 60 9A A2 3B 20 60 9A
9A38- A2 64 20 60 9A A2 83 20
9A40- 60 9A A2 86 20 60 9A A2
9A48- 0F A9 88 20 72 9A A9 4C
9A50- 8D B4 9A A2 72 A9 F8 20
9A58- 72 9A A9 20 8D 17 9B 60
9A60- 38 BD CF DA E5 FA 9D A6
9A68- 9A BD D0 DA E5 FB 9D A7
9A70- 9A 60 18 69 A6 9D A6 9A
9A78- A9 9A 69 00 9D A7 9A 60
9A80- 00 A2 88 BD CE DA 9D A5
9A88- 9A CA D0 F7 60 A9 CF 38
9A90- E9 A6 85 FA A9 DA E9 9A
9A98- 85 FB 60 00 00 00 53 9A
9AA0- 53 99 53 98 2D 98 20 14
9AA8- 9B 20 87 00 F0 24 F0 29
9AB0- C9 C0 F0 39 4C 2E 9B F0
9AB8- 34 C9 2C 18 F0 1C C9 3B
9AC0- F0 44 20 7B D0 24 11 30
9AC8- DD 20 34 ED 20 E7 E3 4C
9AD0- A6 9A A9 0D 20 5C DB 49
9AD8- FF 60 A5 24 C9 18 90 05
9AE0- 20 D2 9A D0 21 69 10 29
9AE8- F0 85 24 90 19 08 20 F5
9AF0- E6 C9 29 F0 03 4C C9 DE
9AF8- 28 90 07 CA 8A E5 24 90
9B00- 05 AA E8 CA D0 06 20 B1
9B08- 00 4C AE 9A 20 57 DB D0
9B10- F2 20 E7 E3 20 00 E6 20
9B18- 9E 9B E8 CA F0 8B B1 5E
9B20- 20 5C DB C8 C9 0D D0 F3
9B28- 20 D7 9A 4C 1B 9B C9 C5
9B30- F0 0E C9 81 F0 24 C9 23
9B38- F0 5C C9 C3 18 4C B7 9A
9B40- 20 F3 E6 20 BE DE 20 EA
9B48- F7 20 F8 E6 A9 3B 20 C0
9B50- DE 20 59 F2 20 B7 00 4C
9B58- AE 9A A9 20 85 F9 8D EC
9B60- 9C 20 B1 00 C9 21 F0 26
9B68- 30 0A C9 26 10 06 8D EC
9B70- 9C 20 B1 00 20 F8 E6 8E
9B78- EA 9C 20 BE DE 20 FB E6

*9880.9CEC

9880- 8E EB 9C A9 3B 20 C0 DE
9888- 20 B7 00 4C AE 9A A9 2A
9890- 85 F9 A9 24 D0 D8 85 E3
9898- 20 B1 00 4C AE 9A AA A5
9BA0- E3 D0 03 A0 00 60 CA 8A
9BA8- A8 86 FE B9 00 01 C9 45
9BB0- F0 08 88 10 F6 A6 FE 18
9BB8- 90 5B B9 02 01 38 E9 30
9BC0- 0A 85 FC 0A 0A 18 65 FC
9BC8- 85 FC B9 03 01 38 E9 30
9BD0- 18 65 FC 85 FC B9 01 01
9BD8- C9 28 F0 3C 88 84 FE A2
9BE0- 00 AD 00 01 C9 2D D0 04
9BE8- AD 01 01 E8 9D 01 01 A9
9BF0- 2E 9D 00 01 E6 FE C6 FC
9BF8- F0 48 A4 FE B9 00 01 99
9C00- 01 01 88 D0 F7 A9 30 9D
9C08- 01 01 A9 2E 9D 00 01 E6
9C10- FE C6 FC D0 E5 18 90 2A
9C18- A9 45 99 01 01 A0 02 AD
9C20- 00 01 C9 2D 18 D0 01 C8
9C28- B9 00 01 C9 45 18 D0 03
9C30- 38 A9 30 99 FF 00 C6 FC
9C38- F0 05 C8 B0 F6 90 E9 88
9C40- 84 FE A4 FE B9 00 01 C9
9C48- 2E F0 0D 88 10 F6 A4 FE
9C50- C8 84 FE A9 2E 99 00 01
9C58- 84 FD A5 FE 38 E5 FD 38
9C60- ED EB 9C 10 0E AA A4 FE
9C68- A9 30 C8 99 00 01 E6 FE
9C70- E8 30 F7 AD EA 9C 38 ED
9C78- EB 9C C9 01 30 43 38 E5
9C80- FD A8 AD EB 9C F0 01 88
9C88- 98 30 28 F0 1E 18 65 FE
9C90- A8 A6 FE BD 00 01 99 00
9C98- 01 88 CA 10 F6 A5 F9 99
9CA0- 00 01 88 10 FA AD EC 9C
9CA8- 8D 00 01 AE EA 9C A0 00
9CB0- 84 E3 60 AC EA 9C A9 3E
9CB8- 99 00 01 88 10 FA 18 90
9CC0- EA 4C 99 E1 48 A9 BA C9
9CC8- 3A 90 01 60 4C BE 00 D0
9CD0- 1F F0 99 00 C9 BA D0 EF
9CD8- 68 C9 1F D0 E7 A9 22 48
9CE0- A9 9A 48 A9 AB 48 4C B1
9CE8- 00 00 04 00 20

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